WFM2200
SD/HD/3G SDI Waveform Monitor & Generator

User Manual

Tektronix

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User Manual

www.tektronix.com

077-0661-01

Tektronix

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For product information, sales, service, and technical support:
- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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[W2 – 15AUG04]

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General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Replace batteries properly. Replace batteries only with the specified type and rating.

Recharge batteries properly. Recharge batteries for the recommended charge cycle only.

Use proper AC adapter. Use only the AC adapter specified for this product.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in this manual These terms may appear in this manual:

> ⚠ **WARNING.** *Warning statements identify conditions or practices that could result in injury or loss of life.*

> ⚠ **CAUTION.** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and terms on the product These terms may appear on the product:

■ DANGER indicates an injury hazard immediately accessible as you read the marking.

■ WARNING indicates an injury hazard not immediately accessible as you read the marking.

■ CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:

⚠ CAUTION
Refer to Manual

⏻ Standby

Preface

This manual contains the following information to help you use the Tektronix WFM2200 SD/HD/3G SDI Waveform Monitor & Generator:

■ How to set up various waveform displays for monitoring SD-SDI, HD-SDI, and 3 Gb/s SDI video signals.

■ How to set up audio displays to monitor embedded AES/EBU audio signals.

■ How to set up parameters for monitoring auxiliary data, ancillary data, closed captions, and timecode.

■ How to freeze video data.

■ How to set up error logging and alarms.

■ How to operate the instrument remotely.

■ How to navigate instrument menus.

■ How to operate the instrument front panel.

Where to find more information

This product is shipped with a Product Documentation CD that contains various user documents for all users and reference information for system integrators. The following table shows you where you can find this and more information about your product. You can always find the most updated documentation and software for your product on the Tektronix Web site at www.tektronix.com/downloads.

Table i: Product documentation

To read about	Tektronix part number	Use these documents
Installation and safety	071-3018-XX	Installation and Safety Instructions
		Provides installation, safety, general specifications, and compliance information.
		This is a printed manual and is also available on the Web at www.tektronix.com/downloads.
Instrument operation	077-0661-XX	User Manual (this manual)
		In-depth descriptions of instrument operation.
		Available on the Web at www.tektronix.com/downloads.
Content-sensitive help topics	NA	Online Help
		Detailed instrument operation and UI help is available in your instrument by pressing the HELP button on the front panel of the instrument.
		You can also access the online help topics using the remote Web interface. (See page 182, *Remote Web interface*.)

Table i: Product documentation (cont.)

To read about	Tektronix part number	Use these documents
Specifications and procedures for checking instrument performance	077-0662-XX	Specifications and Performance Verification Technical Reference
		Physical, electrical, and environmental specifications; functional checks and performance verification procedures.
		Available on the Web at www.tektronix.com/downloads.
Information about declassifying the instrument	077-0663-XX	Declassification and Security Instructions
		Detailed information about how to sanitize the instrument.
		Available on the Web at www.tektronix.com/downloads.
Information about the WFM200BA battery pack	075-1041-XX	WFM200BA Rechargeable Battery Pack Instructions
		Provides safety, operating, and recycling information for the Lithium-Ion battery pack.
		This is a printed manual and is also available on the Web at www.tektronix.com/downloads.
Information about the WFM200BC battery charger	075-1042-XX	WFM200BC External Battery Charger Instructions
		Provides safety and operating information for the optional, external battery charger.
		This is a printed manual and is also available on the Web at www.tektronix.com/downloads.

Conventions used in this manual

The following icon is used throughout this manual:

Sequence step
or item

1

Getting started

Your instrument was shipped with a printed Installation and Safety Instructions manual which includes safety, compliance, and operating requirements along with power-on, installation, and accessories information. That manual is also available online at www.tektronix.com/downloads. This User manual contains information about operating the instrument.

This chapter will help you set up and begin to use the instrument. It is divided into the following four sections:

- *Product description* describes your instrument and provides a list of key features.

- *Options and optional accessories* lists the options and optional accessories which are available for the instrument.

- *Network installation* describes how to set up your instrument for use on an Ethernet network.

- *Incoming inspection* provides a procedure for verifying the basic operation and functionality of your instrument.

Product description

The WFM2200 SD/HD/3G SDI Waveform Monitor and Generator is a portable baseband video monitor, offering uncompromised monitoring quality for field applications with a large 6.5 inch high-brightness, low-power consumption LED backlit display, and weighing in at less than 4.4 lbs (2 kg).

This instrument provides an array of basic monitoring tools for video (SD, HD, Dual Link, and optional 3G) and audio (Embedded and AES) signals. You can configure the instrument for a full screen or quad-tile display, which allows you to see all of the necessary signal information at a glance. The ANC Data Inspector, Data list, and closed caption decode features are invaluable for troubleshooting problems within the ancillary data space.

You can use the Tektronix patented Timing display and the external reference waveform display to assist in ensuring correct video timing and troubleshooting timing problems. The instrument includes a color bar and pathological video signal generator for troubleshooting signal paths and equipment.

A range of accessories can expand the versatility of the WFM2200 for field operations such as production setup and troubleshooting. The instrument can be powered by the supplied rechargeable/replaceable Li-Ion battery pack or the supplied 100-240 V AC adapter, which provides 19 VDC to the instrument.

Key features   The following key features make this instrument an easy to use, flexible, and effective tool.

Table 1: Key features

Item	Description
Flexible tile displays: Full and Quad Tile	**Quad Tile (4-Tile)**: View four measurement displays at once, one in each tile.
	In Quad Tile mode, the high-resolution LED display provides four concurrent views of a monitored signal (with a maximum of two trace displays at once). The instrument also provides the flexibility to configure each of the four display tiles independently, enabling you to quickly check the integrity of a signal.
	Full: View the active display full screen.
Presets	Customizable presets allow you to quickly save and recall commonly used configurations.
Digital support	Support for digital applications.
Fully digital processing	Fully Digital Processing allows for accurate, repeatable, drift-free operation that surpasses traditional analog designs.
Video and audio test signal generation	Multi-rate color bar and pathological signal generation provides engineers with a simple signal source for quick signal path verification during system and/or equipment setup and troubleshooting.
	You can genlock the signal output with the external reference input signal and you can enable Moving Picture or Moving Circle functions on the output signal.
Waveform display	Traditional waveform displays allow signals to be overlaid or paraded.
Vector display	Vector display with Composite and Component Compass Rose Graticules, and gain, sweep, and magnification controls. Traditional and Lightning Vector displays are available. The latter visualizes both luma and chroma amplitudes, and quantifies inter-channel timing.
Infinite Persistence	All trace displays can also be set, tile by tile, to Infinite Persistence. This mode traces waveforms over time on the same display, providing a visual history of the trace.
Gamut monitoring	Arrowhead, Spearhead, Diamond, and Split Diamond displays offer user-selectable gamut thresholds so that you can set monitoring limits appropriate to a specific operation. Gamut monitoring is fully integrated with the alarm logging and reporting capabilities.
LTC waveform display	Longitudinal Time Code (LTC) is monitored in a frame rate display to allow observation of amplitude and noise, and verify LTC is locked to the video.
External Reference Waveform display	The External Reference waveform display check the external reference signal integrity, including its shape and amplitude. This display is independent of the input video signal.

Table 1: Key features (cont.)

Item	Description
Audio monitoring	Surround Sound display of audio signals and phase relationships of normal channel pairs.
	16-channel embedded AES/EBU audio simultaneous monitoring support with Multichannel Surround Sound [1] display, flexible Lissajous display, and two channel AES/EBU BNC input monitoring. The Lissajous display lets you monitor a user-specified pairing of channel inputs.
	Support and options for viewing and monitoring both levels of normal channel pairs for embedded audio signals.
	Support for audio control packet coding and many popular audio scales, including BBC scales.
Auxiliary data monitoring	Support for monitoring auxiliary data including data conforming to ARIB standards and CEA608, CEA708, AFD, and CGMS-A.
Timing display	A Tektronix proprietary display that simplifies measuring the timing difference between two signals. Using the Timing display enables you to easily compare and correct the timing between two signals.
Closed Captioning support (Option DATA only)	Support for simultaneous decode and display in multiple languages of CC standards (CEA 608 (VBI), CEA 608 (ANC), CEA (608/708), CEA 708, TeletextB (VBI), TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)) with caption text and V-chip information overlaid on the picture (monitor mode). There are also settings for missing or incorrectly inserted closed captioning.
Picture area	Support for standard and custom Safe Graticules for Picture displays that look for incorrect placements of graphics, logos, Black events, and Frozen events. Two Safe Area graticules and Safe Title graticules are supported.
Status screens	Status screens provide content status at a glance.
Error tracking	Configurable alarms and error logging.
Remote control	Full remote control for complete installation flexibility.
Data List display	Examines the contents of all digital formats, structures, and transports and displays the data without any interpolation.
Ancillary data inspector	Allows you to monitor all ancillary data present in a signal.

[1] Audio Surround Sound Display licensed from Radio Technische Werksütten GmbH and Co. KG (RTW).

Options and optional accessories

Your instrument may have been ordered with one or more of the options listed in this section.

Instrument options The following options are available for the instrument:

Table 2: Instrument options

Option	Description
3G	Adds support for 3G-SDI (Level A and Level B) signal formats.
DATA	Adds comprehensive data monitoring, which helps to quickly resolve difficult content quality and reliability issues through closed captioning, subtitles, AFD decode/display and full ANC data support.

Check the installed options.

When the instrument is powered on, you can check which options are installed on your instrument by performing the following steps:

1. Press the **CONFIG** button on the front panel.

2. Use the General knob to navigate to **Utilities**.

3. Press the right arrow button to navigate to the **Utilities** submenu and select **View Instrument Options**. The menu box on the right side of the display shows the installed options.

Optional accessories You can purchase any of the following accessories for your instrument.

Table 3: Optional accessories

Accessory	Description
WFM200BA	Additional Li-Ion rechargeable battery pack. The instrument is shipped with one WFM200BA rechargeable battery pack.
WFM200BC	External battery charger for the WFM200BA rechargeable battery pack.
WFM200FSC	Soft carrying case to protect the instrument with room for the instrument, AC adapter, and battery pack(s).

International power cord options

The instrument was shipped with an AC adapter and one of the following power cord options. Power cords for use in North America are UL listed and CSA certified. Cords for use in areas other than North America are approved by at least one authority acceptable in the country to which the product is shipped.

Table 4: Power cord options

Option	Description
A0	North America power
A1	Universal EUR power
A2	United Kingdom power
A3	Australia power
A5	Switzerland power
A6	Japan power
A10	China power
A11	India power
A12	Brazil power
A99 [1]	No power cord

[1] When ordering the A99 option, it is the responsibility of the end user to be sure that a certified power cord, for the country or region in which it is installed, is used with this instrument.

Service options

You can add any or all of the following service options to any instrument. (See Table 2.)

Table 5: Service options

Option	Description
C3	Adds 3 years of Calibration Service.
C5	Adds 5 years of Calibration Service.
D1	Adds a Calibration Data Report.
D3	Adds 3 years of Calibration Data Report (when ordered with option C3).
D5	Adds 5 years of Calibration Data Report (when ordered with option C5).
R3	Adds 3 years of Repair Service (including the period under warranty). This option is available only at the time that the product is purchased.
R5	Adds 5 years of Repair Service (including the period under warranty). This option is available only at the time that the product is purchased.
R3DW	Adds 3 years of Repair Service (including the period under warranty). This option is available only after the product is purchased.
R5DW	Adds 5 years of Repair Service (including the period under warranty). This option is available only after the product is purchased.

Installation

Your handheld instrument is shipped in a fully enclosed metal chassis with a protective rubber boot. A flange with a threaded hole is provided on the bottom panel for use with a tripod mount.

If you need to install your instrument in a custom application, such as a console, be sure to provide adequate airflow and make sure the intake air to the side vents does not exceed 40 °C. Do not block or restrict the ventilating holes. See the *WFM2200 Specifications and Performance Verification Technical Reference* for the complete operating specifications.

⚠ *CAUTION. To prevent risk of fire, adequate airflow must be maintained. Failure to provide adequate airflow to the instrument could cause the instrument to shut down. Inadequate airflow includes placing the instrument in any small, enclosed room that lacks a ventilation system, such as a closet. If the airflow is restricted or blocked and the instrument does not shut down, the risk of fire is increased and the instrument could be permanently damaged.*

Power requirements This instrument is designed to be powered by a 19 VDC input or by a Li-Ion rechargeable battery pack. However, the instrument will operate from any regulated DC voltage between 11 V and 20 V. Input voltages below 18.5 V should not be used while the battery pack is installed, as the battery pack will discharge until it is below the input voltage level.

AC power. When the instrument operates from an external AC adapter, the following power requirements apply:

⚠ *WARNING. Fire can cause personal injury and/or property damage. To prevent risk of fire, when using an external DC source other than the provided AC adapter, make sure that it has a suitable current limiting device (such as a fuse).*

- A single-phase power source with one current-carrying conductor at or near earth-ground (the neutral conductor).

- The power source frequency must be 50 or 60 Hz, the operating voltage range must be from 100 to 240 VAC, continuous. The typical power draw is 27 W.

⚠ *WARNING. To reduce risk of fire and shock, make sure the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.*

■ Systems with both current-carrying conductors live with respect to ground (such as phase-to-phase in multiphase systems) are not recommended as power sources.

NOTE. Only the line conductor is fused for over-current protection. The fuse is internal and not user replaceable. Do not attempt to replace the fuse. If you suspect the fuse has blown, return the unit to an authorized service center for repair.

■ Use the proper power cord with the AC adapter. (See page 5, *International power cord options*.)

NOTE. See the WFM2200 Specifications and Performance Verification Technical Reference for additional information on power and environmental requirements.

Battery power. This instrument can be powered by a Lithium-Ion rechargeable battery pack. One WFM200BA battery pack is provided with the instrument. If needed, you can purchase additional battery packs.

NOTE. For optimum performance, charge the battery pack completely before using it for the first time or after prolonged storage.

When installed, the battery pack will charge whenever the supplied AC adapter is connected, whether the instrument is On, Off, or in Standby mode. The charging rate is unaffected by instrument operation.

If you are using the WFM200BA battery pack to power the instrument, read the following battery safety notices. See the *WFM200BA Rechargeable Battery Pack Instructions* for information about how to properly operate and maintain the battery pack.

CAUTION. To avoid damage to the battery pack, use only the waveform monitor or the optional WFM200BC battery charger to charge the battery pack. Do not connect any other voltage source to the battery pack.

To avoid overheating of the battery pack during charging, do not exceed the allowable ambient temperature of 0 to 40 °C. The battery pack will stop charging if it gets too hot.

The temperature at which the battery pack will stop charging varies depending on the charging current and the battery heat dissipation characteristics. This is particularly true when the instrument is being operated while the battery pack is charging. The actual battery-charging temperature limit may be lower than 40 °C.

Connect power   This section provides procedures for installing the power cord and installing the battery pack.

Power cord installation.   Connect the AC adapter to the power connector on the instrument top panel as shown below.

NOTE. If a battery pack is installed in the instrument, it will automatically charge whenever the supplied AC adapter is connected, whether the instrument is On, Off, or in Standby mode.
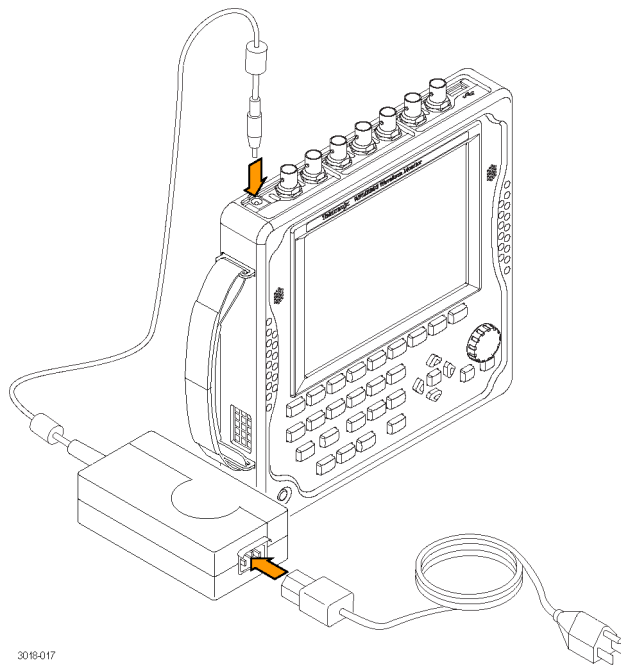
3018-017

Battery pack installation. The WFM2200 waveform monitor is shipped with a WFM200BA Lithium-Ion rechargeable battery pack. Perform the following steps to install the battery pack.

NOTE. For optimum performance, charge the battery pack completely before using it for the first time or after prolonged storage.

The battery pack can be installed, removed, or replaced while the instrument is turned on and operating with the AC adapter.

See the WFM200BA Rechargeable Battery Pack Instructions for more information about the battery pack.

1. On the rear panel of the instrument, remove the cover for the battery compartment:

   a. Lift up the battery-cover ring.

   b. Turn the battery cover ring ¼ turn counterclockwise.

   c. Lift away the battery cover.

2. Insert the WFM200BA battery pack into the battery compartment as shown below.
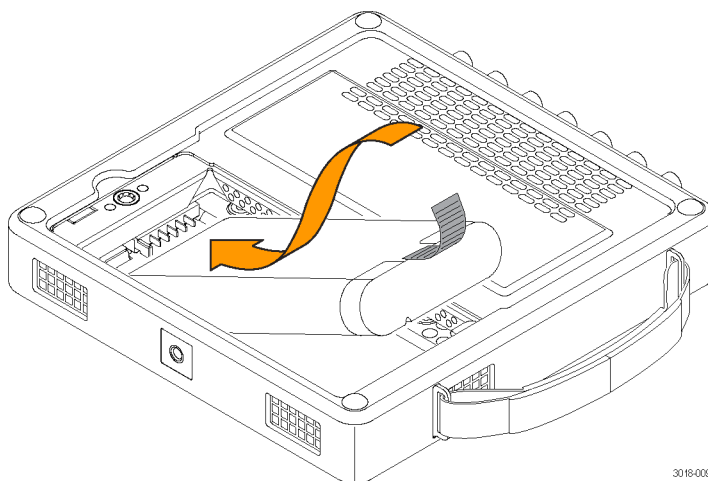
3018-009

3. Secure the battery pack tab as shown below.

Fold the end of the tab between
the battery pack and the chassis
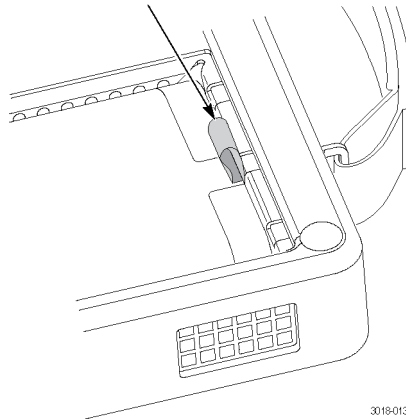
3018-013

4. Replace the battery compartment cover:

a. Insert the three tabs on the battery cover into the chassis slots as shown below.

Insert the three tabs
into the chassis slots
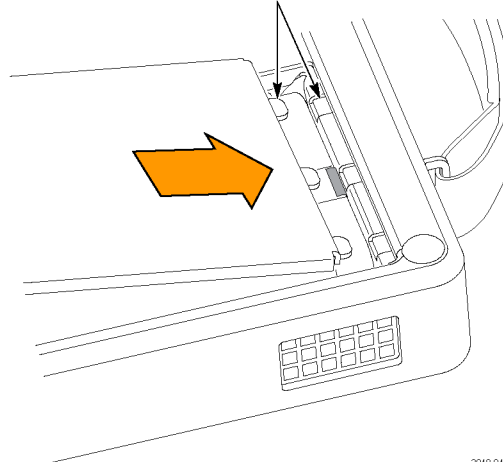
3018-014

b. Close the battery cover and turn the battery cover ring ¼ turn clockwise to secure the cover.

c. Press the battery cover ring down so that it latches into place as shown below.

Make sure that the battery
cover ring lies flat and is held
down by the rubber boot
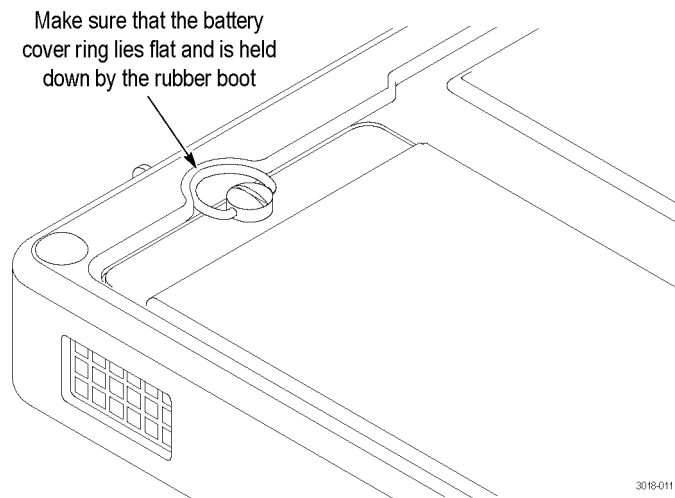
3018-011

Power-on and power-off procedures

This section provides procedures for powering the instrument on and off.

Power-on procedure. Perform the following steps to power on the instrument:

1. Connect power to the instrument:

   - AC adapter. Connect the AC adapter to the power connector on the instrument. (See page 8, *Power cord installation*.)

   - Battery pack. Install the WFM200BA battery pack. (See page 9, *Battery pack installation*.)

2. Press the Power button on the instrument front panel to turn the instrument on.

3. If you are powering the instrument using only the battery pack, check the power level before operating the instrument. (See page 13, *Battery charge level indicators*.)

Power-off procedure. There are two methods for powering off the instrument:

■ Press the Power button on the front panel. This opens the Power off or Standby dialog box where you can use the arrows buttons to select from the following actions:

NOTE. When you press the Power button, you must make a selection in the Power off or Standby dialog box within 5 seconds or the instrument will automatically power off.

   - **Power off**. This is the default selection. You can press the **SEL** button to immediately power off the instrument or you can wait 5 seconds for the instrument to automatically power off.

   - **Standby**. Use the arrow buttons to select Standby to put the instrument in Standby mode. In Standby mode, the instrument consumes less power than when it is turned on and also takes less time to turn back on than when the instrument is turned completely off.

   - **Cancel**. Use the arrow buttons to select Cancel if you want to cancel the power-off operation.

■ Press and hold the Power button for 5 seconds and then release the button to immediately power off the instrument.

NOTE. To remove power completely from the instrument, disconnect the AC adapter from the power connector and remove any installed battery pack.

Battery charge level indicators. When the WFM200BA battery pack is not installed in the instrument, you can check the charge level by pressing the Check button on the back of the battery pack. LEDs will illuminate to indicate the amount of charge remaining in increments of approximately 20%.
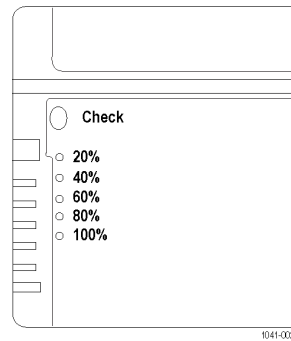
When a battery pack is installed in the instrument, the charge level meter is shown on the bottom right of the status bar. The following table shows examples of the meter icons.

Table 6: Battery charge-level meter icons

Item	Description
	Battery fully charged, AC adapter plugged in
	Battery partially charged, AC adapter plugged in and charging
	Battery level low, AC adapter not plugged in
	Battery level critically low, AC adapter not plugged in

Tripod installation   The bottom panel provides a ¼-20 threaded hole that can be used to mount the instrument on a camera tripod as shown below.
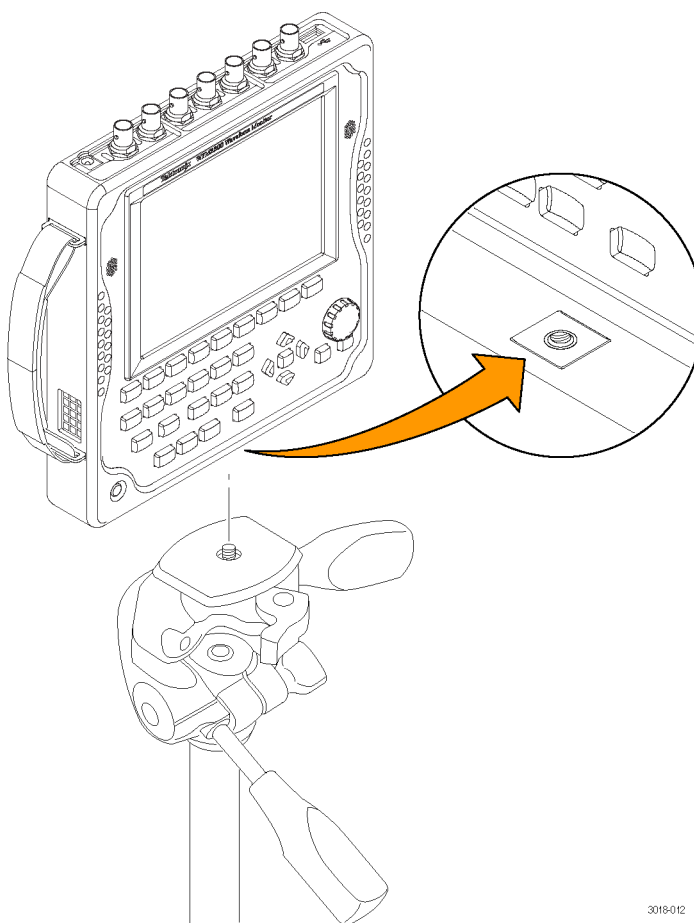
3018-012

Video system installation   The instrument can operate almost anywhere in the distribution system where serial digital system monitoring is needed.

Line termination.   The video inputs (SDI A, SDI B, and REF IN) each have 75 Ω internal terminations.

Compatibility of BNC center pins.   Most BNC connectors for video equipment, whether 50 Ω or 75 Ω, use a 50 Ω standard center pin. Some laboratory 75 Ω BNC connectors use a smaller diameter center pin. The BNC connectors on the instrument are designed to work with the 50 Ω standard (large diameter) center pins.

Do not use connectors or terminators with the smaller center pins. They could cause intermittent connections.

To monitor the video bit stream of a serial receiver. Route one or more incoming serial signals into the SDI inputs on the instrument.
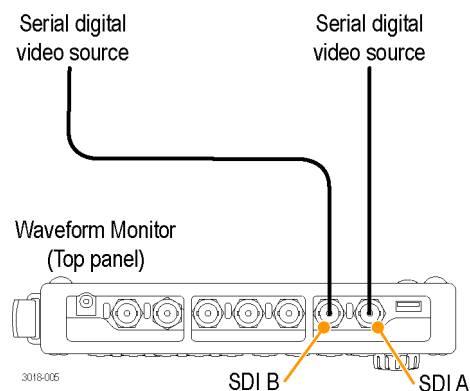
Serial digital video source   Serial digital video source

Waveform Monitor
(Top panel)

3018-005

SDI B   SDI A

NOTE. *See the WFM2200 Specifications and Performance Verification Technical Reference for the maximum allowed cable lengths.*

To monitor the embedded audio signal in a serial digital video stream. Route the incoming serial signal into one of the SDI inputs on the instrument.

Serial digital video source

Waveform Monitor
(Top panel)

3018-006

SDI B
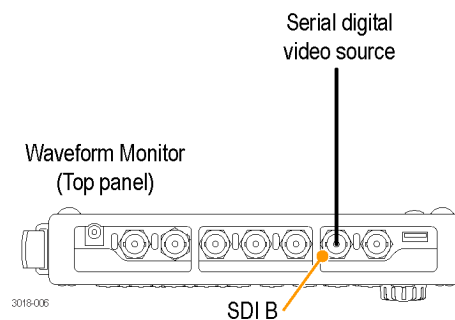
To monitor the external reference signal. Route the incoming reference signal into the REF IN input on the instrument.

Analog video reference source

Waveform Monitor
(Top panel)

REF IN   3018-007
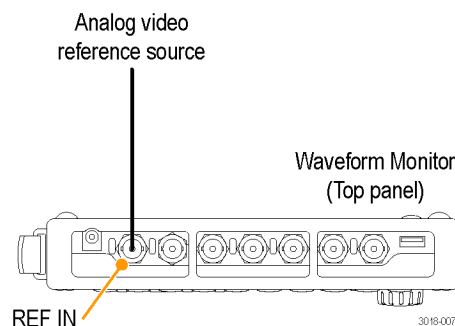
To genlock the SDI output test signal to the external reference signal

To genlock the SDI output test signal to the external reference signal, use the CONFIG > Outputs > Test Signal Genlock menu to enable the genlock function and to configure the genlock vertical and horizontal timing offsets. The Generator Status display and the Status Bar indicate the status of the genlock function.

Configure the network interface

An Ethernet connection to the instrument is required for some instrument functions such as the following:

- Accessing the remote interface of the instrument

- Remotely controlling the instrument using SNMP commands

- Upgrading the instrument software

Configure the IP address

Perform the following steps to configure the IP address of the instrument:

1. Make one of the following Ethernet connections:

   - If you have a local Ethernet network, connect the instrument and computer to the network.

   - If you do not have a local Ethernet network, connect the computer directly to the instrument using an Ethernet cable. The instrument has an auto-crossover feature, so you do not need a crossover cable. You can also use a network HUB connection between the PC and the instrument.

2. Press the Power button to power on the instrument.

3. Assign the instrument an IP address:

NOTE. When the instrument is connected to your local network, the instrument must be assigned a valid IP address to operate on your network. The instrument is shipped with a default IP address of 192.168.1.1, but the address will usually not be valid on your local network.

The network addresses of the instrument can be assigned either manually or automatically using DHCP. If your network does not use DHCP, you will have to manually enter the address for the instrument. In that case, contact your local LAN administrator to obtain the valid network addresses.

Alternatively, when you connect the computer directly to the instrument using an Ethernet cable, you can manually assign the instrument any IP address that is compatible with the IP address for the Ethernet interface of the computer.

---

   a. Press the **CONFIG** button on the front panel.

   b. Navigate to **Network Settings** > **IP Config Mode**.

    c. Set the IP configuration mode:

- If you connected the instrument to your local network, select either **Manual** or **DHCP** as directed by your LAN administrator.

- If you connected the instrument directly to your computer, select **Manual**.

    d. If you set the IP configuration mode to Manual, perform one of the following tasks:

- If you connected the instrument to your local Ethernet network, enter the IP address, subnet mask, and gateway address as directed by your LAN administrator.

- If you connected the instrument directly to your computer, enter an IP address that is compatible with the IP address for the Ethernet interface of the computer. For example, if the IP address of the computer is 199.55.142.12, then set the IP address of the instrument to 199.55.142.x, where x ≠ 0, 12, or 255.

  Set the subnet mask to the same value used by the computer. Set the gateway address to be the address of the computer.

NOTE. If you selected DHCP mode, the network automatically assigns the instrument an IP address. DHCP typically requires several seconds to assign the network address.

    e. Press the **CONFIG** button on the front panel to close the menus.

Enable the Web remote interface

Before you can access the instrument using a Web browser, the Web remote interface of the instrument must be enabled. Optionally, you can create a password which would then be required to gain access to the instrument using a Web browser. (See page 182, *Remote Web interface*.)

NOTE. The instrument is shipped with the Web remote interface disabled and no password required to gain access to the instrument using a Web browser.

Perform the following steps to enable the Web remote interface:

1. Press the **CONFIG** button.

2. Navigate to **Network Settings** > **Web Enable**.

3. Select **On** to enable the Web remote interface.

4. To create a password that would be required to gain remote access to the instrument using a Web browser, perform the following steps:

   a. Navigate to **Web Password** and press the right-arrow key to change the menu focus to the submenu. This opens the Web Password display.

   b. Use the left/right arrow keys to move the highlight to the desired box in the password. Use the up/down arrow keys or the knob to change the text in each box as required.

   c. To accept, clear, or cancel your changes, move the highlight to the respective selection box and press the **SEL** button.

5. Press the **CONFIG** button on the front panel to close the menu display.

Configure and enable SNMP control

If you intend to use SNMP commands to remotely control the instrument (SNMP control is primarily intended for access through automation systems), you must enable SNMP and configure the SNMP parameters of the instrument.

NOTE. The wfm_mon.mib and wfm2200.mib files contain the SNMP OIDs for the WFM2200 waveform monitor. These files can be downloaded from the home page of the Web remote interface.

Perform the following steps to configure and enable SNMP control:

1. Press the **CONFIG** button and navigate to the **Network Settings** submenu.

2. Set the Public Community string as follows. This string is effectively a password and is required before SNMP commands can read values from the instrument. The default string value is "public".

   a. Navigate to **SNMP Public Community**, and then press the right arrow key to open the SNMP Public Community edit box.

   b. Use the left and right arrow keys to move the highlight to each box in the string. For each box in the string, use the up and down arrow keys to change the entry as required for your installation.

   c. To accept, clear, or cancel the changes, select the appropriate selection box and press the **SEL** button.

3. Set the Private Community string as follows. This string is effectively a password and is required before SNMP commands can read or write changes into the instrument. The default string value is "private".

   a. Navigate to **SNMP Private Community**, and then press the right arrow key to open the SNMP Private Community edit box.

   b. Use the left and right arrow keys to move the highlight to each box in the string. For each box in the string, use the up and down arrow keys to change the entry as required for your installation.

   c. To accept, clear, or cancel the changes, select the appropriate selection box and press the **SEL** button.

4. Set the SNMP trap addresses as follows. You can configure up to four IP addresses to which SNMP traps are sent through SNMP when error conditions are detected.

NOTE. The default value for the SNMP trap addresses is all zeroes, which disables the trap outputs.

   a. Navigate to **SNMP Trap Address 1**, and then press the right arrow key to open the SNMP Trap Address edit box.

   b. Use the left and right arrow keys to move the highlight to each box in the address. For each box in the address, use the up and down arrow keys to change the entry as required for your installation.

   c. To accept, clear, or cancel the changes, select the appropriate selection box and press the **SEL** button.

   d. Repeat steps a through c for the other three SNMP trap addresses as required for your installation.

5. Navigate to **SNMP Enable** and press the right arrow key to select **On**. This setting turns SNMP remote access to the instrument on and off.

6. Navigate to **SNMP Trap Enable** and press the right arrow key to select **On**. This setting turns the traps that are sent out from the instrument through SNMP on and off.

7. Press the **CONFIG** button on the front panel to close the menu display.

Incoming inspection

The incoming inspection procedures are basic optional procedures to check the functionality of your instrument. These procedures require no external equipment.

For a more robust inspection, see the performance verification procedures in the *WFM2200 Specifications and Performance Verification Technical Reference*.

Basic turn on and self test

1. Connect power to the instrument. (See page 8, *Connect power*.)

2. Turn the instrument on. (See page 12, *Power-on procedure*.)

3. After about 30 seconds, the power-on diagnostic page should appear on the screen.

4. Verify that all self tests pass. Any failures are shown in red.

NOTE. Although the results of the power-on diagnostics are erased from the screen during the power-on process, you can view the results by selecting **CONFIG > Utilities > View Diagnostics Log > SEL** *or by viewing them on the instrument Web page.*

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5. After the diagnostics are finished, the instrument state is restored. When the progress indicator in the status bar is finished, the instrument has finished initializing.

Front panel test

1. Reset the instrument settings to the Factory Presets:

   a. Press and hold the **PRESET** button to open the Preset menu.

   b. Select **Recall Preset** > **Recall Factory Preset**, and then press the **SEL** button. Wait for the process to complete as indicated by the progress indicator.

2. Press the **HELP** button to display the online help.

3. Press each of the front panel buttons, one at a time, except for the **Power** button and the **HELP** button.

   Each button should flash as you press it.

4. Press the right arrow key until the Help Contents pane in the upper-left corner is highlighted.

5. Turn the knob and verify that the selector box moves up and down the list of topics.

6. Press the **HELP** button to exit the online help.

Fan test

1. You should be able to hear the fans and feel air coming out of the back of the instrument. At low temperatures, the fans will turn slowly and be very quiet.

2. Press and hold the **GEN** button to open the Generator pop-up menu.

3. Use the arrow keys to select **Display Type > Diag Monitor** to open the Diagnostics Monitor display.

4. If necessary, use the up and down arrow keys to view **Page 1 of 4** of the display. The page number is located in the upper right corner of the display.

5. The fan speed in rpm (revolutions per minute) is shown at the top of the display for each of the two internal fans. The fan speeds should be fairly equal.

Storing or shipping the instrument

⚠ **CAUTION.** *To prevent damage to the Li-Ion battery pack and the instrument, observe the following precautions when storing or shipping the instrument:*

- *Do not store the battery pack in the instrument when the instrument is not in use.*

- *Remove the battery pack before shipping the instrument.*

To repackage the Li-Ion battery pack for shipment
See the *WFM200BA Rechargeable Battery Pack Instructions* that was supplied with the battery pack for information about handling, storing, shipping, and recycling Li-Ion battery packs.

⚠ **CAUTION.** *To prevent damage to the Li-Ion battery pack, use the original packaging when shipping the battery pack and ensure that the package labeling and documentation meets all of the requirements for shipping Li-Ion batteries under the IATA Dangerous Goods Regulations.*

To repackage the instrument for shipment
Use the following instructions to prepare your instrument for shipment to a Tektronix, Inc., Service Center:

⚠ **CAUTION.** *Remove the battery pack when transporting or storing the instrument in an enclosed container.*

1. Attach a tag to the instrument showing: the owner, complete address and phone number of someone at your firm who can be contacted, the instrument serial number, and a description of the required service.

2. Package the instrument in the original packaging materials. You can contact Tektronix to obtain replacement packaging.

   If you cannot use the original packaging materials to package the instrument, follow these directions:

   a. Obtain a carton of corrugated cardboard having inside dimensions six or more inches greater than the dimensions of the instrument. Use a shipping carton that has a test strength of at least 250 pounds (113.5 kg).

   b. Surround the module with a protective (anti-static) bag.

   c. Pack dunnage or urethane form between the instrument and the carton. If using Styrofoam kernels, overfill the box and compress the kernels by closing the lid. There should be three inches of tightly packed cushioning on all sides of the instrument.

3. Seal the carton with shipping tape, industrial stapler, or both.

Getting acquainted with your instrument

Front-panel controls

Three levels of control   You control the instrument on three levels:

- **Frequently changed settings.** The front panel buttons control the most commonly changed parameters, such as which measurement appears in each tile. Use the knob and navigation buttons to adjust levels and make selections.

- **Tile-specific settings.** Pop-up menus control parameters that are specific to the tile in which they are displayed. The pop-up menus control less frequently changed parameters such as the waveform display mode (for example, changing the waveform display mode from RGB to YPbPr). To display a pop-up menu, press and hold the desired button for about two seconds.

- **Instrument-wide settings.** The parameters in the Configuration menu are instrument-wide settings. The configuration menu controls settings that are changed only occasionally, such as changing waveform color or setting the network address.

Scope of controls   Some controls are global and affect all tiles, while other controls only affect the active tile. Generally speaking, if a control is configured by front panel buttons or by a pop-up menu, it is tile specific. (Exceptions are the Input and Ref buttons, and all audio and generator features, each of which are global.)

If a control is configured by the Configuration menu, the selections are always global. The settings in the Display, Main, and Preset menus are also global.

The Capture button can be either global or tile specific depending on the setting in the Configuration menu (Display Settings > Freeze Affects).

Layout and usage
The primary front panel elements shown below are described in the table that follows. The Description / usage procedure column in the table refers you to a procedure in this manual that explains how to use the element. If there is no page reference, the information given explains the basic function of the element.

3018-008

Control element or group	Description / usage procedure
Preset button	Press to save or recall presets using the bezel buttons. Press and hold to access the Preset menu. (See page 128, *Presets*.)
Measurement buttons (WFM, VECTOR, PICT, AUDIO, GAMUT, STATUS, MEAS, GEN)	Press these buttons to select one of the instrument displays. (See page 30, *To select a display*.)
Scaling buttons (SWEEP, MAG, GAIN, VAR)	Press these buttons to select how the signal trace is displayed. (See page 118, *Gain, sweep, and magnification*.)
Line Select button	Press the **LINE** button to enable or disable the Line Select mode. When enabled, use the General knob and arrow buttons to select which line and field to display. In the Datalist display, press the SEL button to toggle between line and sample select. (See page 125, *Line select*.)

Control element or group	Description / usage procedure
CURSOR button	Press this button to enable or disable the measurement cursors. When enabled, use the General knob and the arrow buttons to adjust the cursor positions. Press and hold to access the Cursor pop-up menu. (See page 122, *Measurement cursors (Waveform display only)*.)
HELP button	Press this button to display context-sensitive online help for the selected display mode or menu item. Use the General knob and the arrow buttons to navigate the online help content. When online help is displayed, you can press most of the front panel buttons to access information about those buttons. (See page 29, *To navigate online help*.)
CAPTURE button	Press this button to capture an image of the selected display. Press and hold to access the Capture pop-up menu where you can compare a captured display image with the live display. (See page 124, *Display capture (freeze)*.)
Setup buttons (DISPLAY, MAIN, CONFIG)	Press the **DISPLAY** button to access menu selections to adjust various display levels, to enable the Infinite Persistence mode, and to save a copy of the instrument display to a device connected to the USB port.
	Press the **MAIN** button to access menu selections to select the tile display mode, to check the USB port status, and to configure the function of the Display Select button (selecting a display or turning the Thumbnail view on/off).
	Press the **CONFIG** button to access menu selections to configure various instrument parameters, to check for installed options, to set network parameters, to perform a system upgrade, and more.
Input selection buttons (INPUT A, INPUT B)	Press these buttons to select which video input to monitor: SDI A or SDI B. (See page 38, *Signal inputs and outputs*.)
EXT REF button	Press this button to toggle the synchronization source between the internal reference signal or the analog video reference signal connected to the REF IN input. (See page 15, *To monitor the external reference signal*.)
	(See page 185, *Timing a studio*.)

Control element or group	Description / usage procedure
DISPLAY SELECT / Thumbnail button	Press this button to move the tile selection from one tile to another. Press and hold to toggle between Full Screen and 4-Tile display modes.
	The default setting for this button is as a tile select button. You can configure this button using the **MAIN** button menu to toggle the thumbnail view of the picture on and off in the selected tile. The position of the thumbnail is determined automatically.
Arrow keys and SEL button	Press the up/down/left/right arrow keys to navigate between menu panes and selections or to increment/decrement values. Press the **SEL** button to set the selected parameter.
General knob	Turn the General knob to select or adjust a parameter and to navigate through a menu or online help. When the General knob is enabled, a knob icon appears next to the enabled parameter to indicate which parameter is controlled by the knob.
Position button	Press the **POS** button, and then use the General knob to position traces on the Waveform, Vector, Lightning, and Bowtie displays. Use the up/down arrow buttons for finer adjustments and use the left/right arrow buttons to switch between horizontal and vertical adjustments.
Volume button	Press the **VOL** button, and then use the General knob and the up/down arrow buttons to adjust the volume. When the Audio tile is selected and no menus are active, the General knob controls the volume.
	When monitoring high-amplitude audio, volume levels over 90% may cause audio clipping.
	⚠ *WARNING. To prevent risk of hearing damage, always turn down the headphone audio level before connecting a headphone into the headphone jack. Sound levels and impedance can vary between headphones.*
Power button	Press to put the instrument in Standby mode or to turn the power on or off. (See page 12, *Power-on and power-off procedures*.)
	NOTE. The Power button does not remove power from the instrument.

Online help

Press the **HELP** button to access the instrument online help. (See Figure 1.) Use the online help when you have questions about buttons, features, or operations related to your instrument. The online help is:

■ Context-sensitive. The topic displayed depends on what is displayed in the active tile when the online help is selected or what control is operated after help is selected.

■ Navigable. The Contents and Topic Selector panes, with links within the topics, provide access to topics.
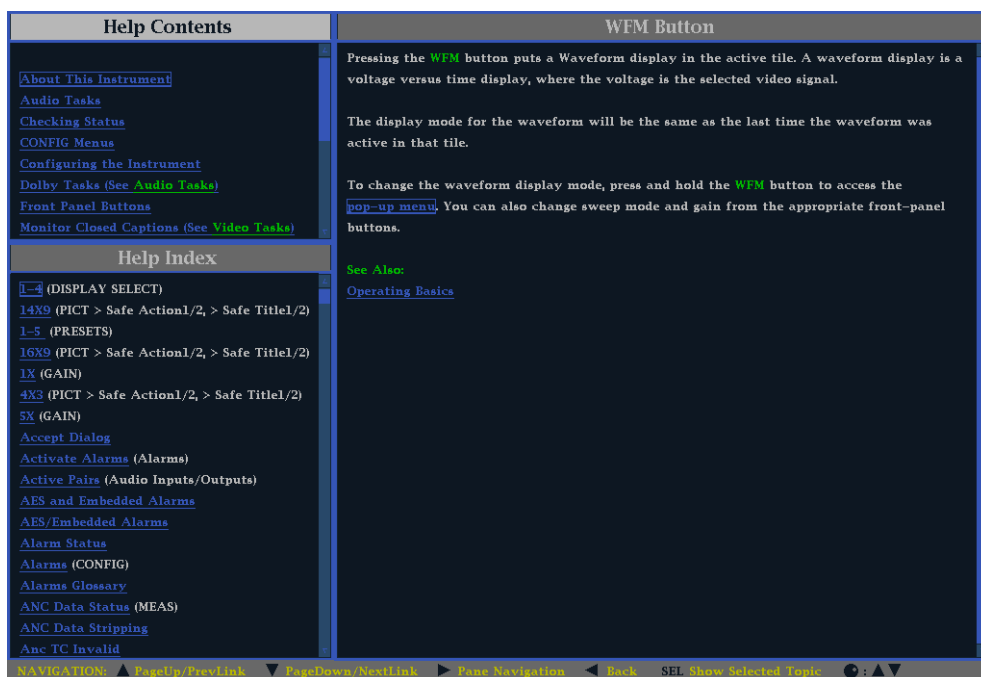
Figure 1: Instrument online help

To navigate online help

1. Press the **HELP** button to open online help.

2. Press the right arrow key to navigate to the one of the three panes: **Help Contents**, **Help Index**, or the right-side pane that contains the topic content related to the front panel button you press while help is activated or the links in the help files and menus you use.

3. Use the General knob or the up/down arrow keys to highlight an entry in the Contents (entries never change) or the Index, or to highlight a link in the topic pane.

4. Press the **SEL** button to select the highlighted item.

5. Press the **HELP** button again to exit online help.

Instrument display

This instrument uses Quad Tile, which is a flexible, four-tiled display that can show four tiles at one time or a single, full-screen sized tile. The instrument also provides the flexibility to configure each of the four display tiles independently, enabling you to quickly check the integrity of a signal.

Supported displays

This instrument supports the displays listed below. For detailed information about each of the displays, see *Display modes*. (See page 43.)

> *NOTE. Some displays require a specific option to be installed. For example, the ANC Data display is not accessible unless you have Option DATA. (See page 4, Options and optional accessories.)*

- Waveform: YPbPr, YRGB, RGB, SDI → Composite or XYZ

- Vector: Normal, SDI → Composite, Lightning

- Gamut: Arrowhead, Diamond, Split Diamond

- Measure: Timing, Datalist, Bowtie, ANC Data

- Status: Error Log, Alarm Status, Video Session, Audio Session, Dolby Status, Audio Control, AES Channel Status, Auxiliary Data Status

- Audio: Phase, Surround

- Picture: Picture frame (on/off) and various closed caption and safe area graticules

- Generator: Generator Status, Diagnostics Monitor

To select a display

Push a front panel button corresponding to the display that you want to view and one of the following selected displays will appear:

- **WFM**: display of video waveform, Longitudinal Time Code (LTC) waveform, or External Reference waveform

- **VECTOR**: display of vector and lightning plots of color signals

- **PICT**: display of the picture generated by the video signal

- **AUDIO**: display of levels (meters), phase (plot), and surround sound for monitoring audio signals

- **GAMUT**: display of one of four views for checking the gamut of an SDI signal

- **STATUS**: display of extensive views of signal status

■ **MEAS**: display of various measurements, including timing, audio video delay, ANC data, and Data List

■ **GEN**: display of status and configuration of the SDI video and AES audio test signal generators or information from the Diagnostics Monitor

Pop-up menus   All pop-up menus are displayed by pressing and holding the specified display button for three seconds. To hide a pop-up menu, press the specified button again. Pop-up menus appear in the active tile and, in general, control only settings specific that tile. A pop-up menu will not appear if it is not appropriate for the current instrument setting.

To set display parameters   Use the pop-up menus to set up the measurements that you display.

1. Select a tile by pressing the **Display Select** button.

2. Press and hold a display button and the display and the pop-up menu for that display appears.

NOTE. The selections in a pop-up menu can change depending on settings.

3. Use the right and left keys to move between menu panels. The instrument surrounds the panel selected with a blue border.

4. Use the up and down arrow keys to select parameters in a menu. (See Figure 2.)

0253-007
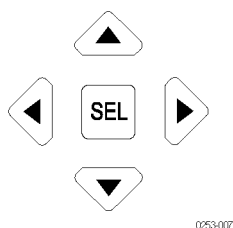
Figure 2: Navigate menus using the arrow keys and select button

5. Navigate through the menu and make your selections.

DISPLAY SELECT button

You can configure the DISPLAY SELECT button to function in one of the following two modes:

- Tile selection. Select one of the four tiles while in 4-tile mode and change from 4-tile to full-screen mode and back again.

- Thumbnail view. Toggle on or off the thumbnail view of the picture display in the Waveform, Vector, or Gamut displays. The Waveform, Vector, or Gamut display must be in full-screen mode to activate the thumbnail view.

Button configuration. Perform the following steps to configure the function of the DISPLAY SELECT button:

1. Press the **MAIN** button to display the Main menu.

2. Navigate to **Display Select**.

3. Press the right arrow key to select **Thumb** or **Tile Sel**.

4. Press the **MAIN** button to close the Main menu.

Tile selection mode. When the DISPLAY SELECT button is configured for tile selection, the button functions as follows:

- In 4-tile mode, press the DISPLAY SELECT button to move the active tile selection to the next tile. The selected (active) tile is outlined in blue. The tile numbers and their associated quadrants are shown below.
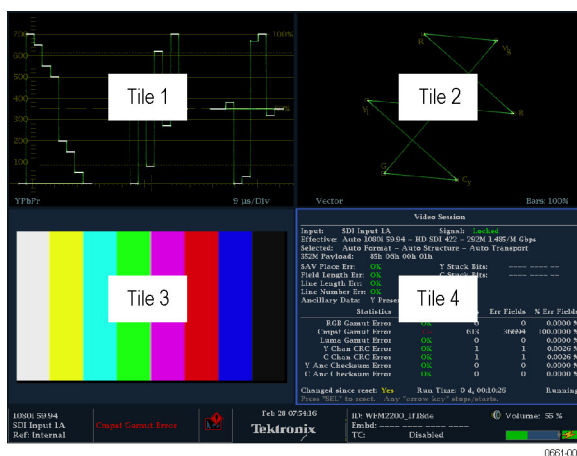
Figure 3: Display quadrants and related tile numbers

■ In full screen mode, press the DISPLAY SELECT button to change the display to the next tile. In full screen mode, the same four displays are available as in 4-tile mode.

■ Press and hold the DISPLAY SELECT button to toggle between 4-tile and full screen mode. The selected (active) tile in 4-tile mode is the tile expanded to full screen mode. (See Figure 4.)

NOTE. *You can also use the Main menu to toggle between 4-tile and full screen mode and to select the active tile.*
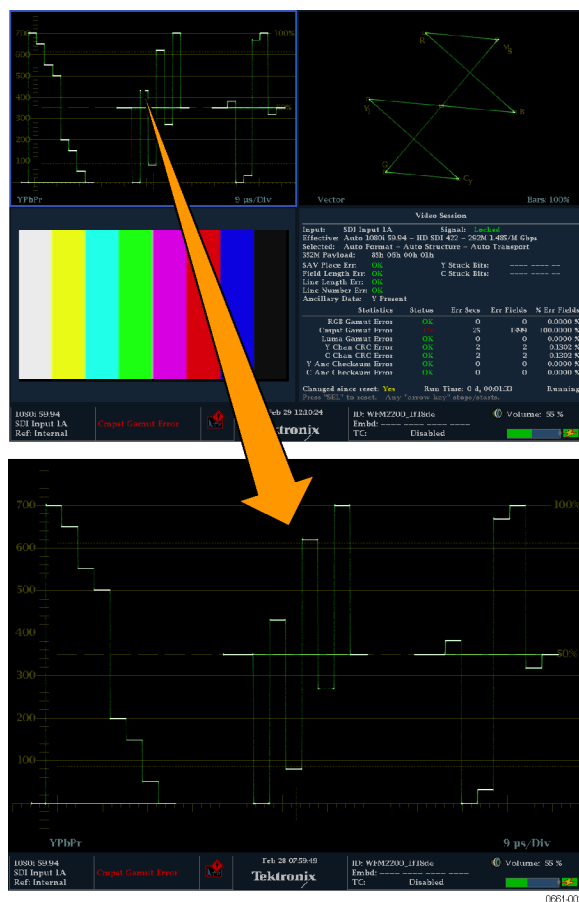
Figure 4: Changing from 4-tile to full-screen view

Thumbnail view mode. When the DISPLAY SELECT button is configured for Thumbnail view and the thumbnail view is enabled, the button functions as follows:

NOTE. When the Display Select setting is set to Thumbnail in the Main menu, pressing the DISPLAY SELECT button will toggle the thumbnail view on and off. This is equivalent to toggling the CONFIG > Display Settings > Thumbnail setting.

The thumbnail view is not shown when the Picture display is visible in any tile.

- In full screen or 4-tile mode with no Picture display in any tile, press the DISPLAY SELECT button to toggle the thumbnail view of the picture display on and off. The button stays illuminated when the thumbnail view is turned on.

- In 4-tile mode, the placement of the thumbnail view is determined automatically. However, the placement is usually in the highest numbered tile containing a trace display, and then on status displays.

The following figure shows a full screen Waveform display with the thumbnail view enabled. In full screen mode, the thumbnail is always positioned in the lower right region of the display.
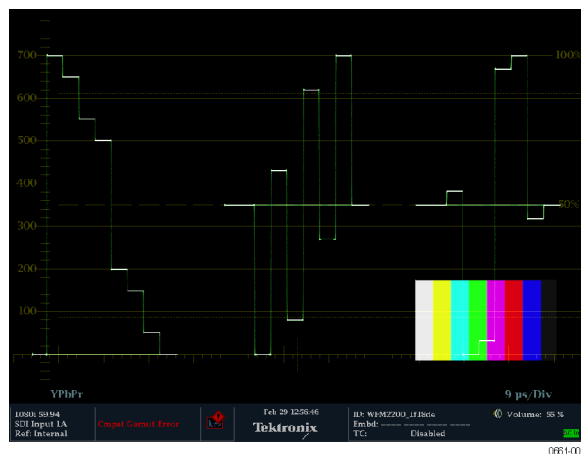
Figure 5: Thumbnail view in Waveform display

Status bar   The Status bar is located on the bottom of the instrument display and shows instrument status, the type of signal being monitored, some alarms associated with that signal, and other information. (See Figure 6.)
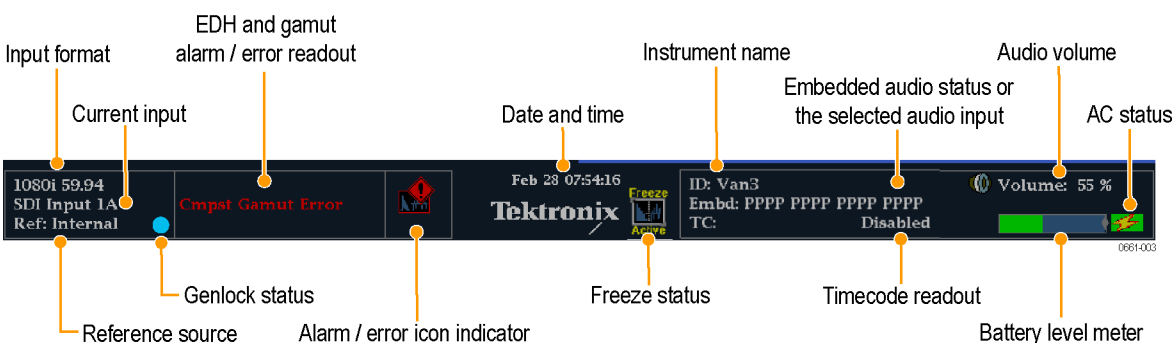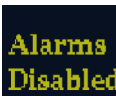
Figure 6: Elements of the Status bar

Status display element	Description
Input format	Text indicating the format of the signal or whether the signal is missing of unlocked.
Current input	Text indicating the selected SDI input: ■ 1A or 1B for standard SDI signals ■ 1DL for dual link signals
Reference source	Text indicating the source of the current reference. When the reference source is set to internal, "Internal" is always displayed. When the reference source is set to external, the text indicates the reference format (such as NTSC) or whether the reference is missing or unlocked.
Genlock status	Icon indicating the status of the reference signal used for the genlock output of the SDI test signal. The color of the icon indicates the status: ■ Blue indicates that genlock is currently not enabled for the SDI output signal. ■ Green indicates that genlock is currently enabled and locked to the SDI output signal. ■ Red indicates that genlock is currently enabled but is not locked to the SDI output signal. ■ Yellow indicates that genlock is currently enabled but a lock is still being acquired for the SDI output signal.

Status display element	Description
EDH and gamut alarm/error readouts	Readouts indicating that EDH or gamut errors are present. The following readouts appear only if the alarms have been enabled for screen text/icon notification in the CONFIG menu: ■ EDH Error: This readout appears when EDH errors are present. ■ RGB Gamut Error: This readout appears when RGB gamut errors are present. ■ Cmpst Gamut Error: This readout appears when Composite gamut (Arrowhead) errors are present. ■ RGB and Cmpst Gamut: This readout appears when both RGB and Composite Gamut errors are present at the same time. ■ Luma Gamut Error: This readout appears when Luma errors are present.
Alarm/error icon indicator	An icon that appears when alarms that have been configured for screen text/icon notification in the CONFIG menu occur. The icon will also appear when alarms are active but have been muted or disabled.
Date and time	A readout of the instrument date and time (set in **CONFIG** > **Utilities**).
Instrument name	A readout showing the name assigned to the instrument in the **CONFIG** > **Network Settings** menu.
Audio status	An up to 32-character string indicating the selected audio input (AES A) or the embedded audio channel status, when embedded audio is the selected input. In the latter case, each character shows the status of a specific channel: **–** for not present and **P** for present.
Timecode readout	A readout showing the selected time-code value. Also indicates if the time code is disabled.
Audio volume	A readout showing the audio volume setting in the **CONFIG** > **Audio Inputs/Outputs** menu.
Battery level meter	When a battery pack is installed, a meter showing the battery charge level is displayed. (See page 13, *Battery charge level indicators*.)
AC status	An icon that indicates whether the AC adapter is plugged in and/or charging the battery pack. (See page 13, *Battery charge level indicators*.)

Status bar icons. The following table describes the Status bar icons.

Icon	Description
	Warning - Appears when an error or an alarm that is mapped to the user interface triggers.
	Alarms Muted - Appears when the alarms are muted from the **STATUS** pop-up menu.
	Remote Access - Appears when the instrument is accessed from the network. For example, when sending commands to the instrument from the remote interface.
	Alarms Disabled - This text appears in the Status Bar when Alarms are disabled from the Configuration menu.
	Freeze Active - Appears when the tiles are frozen or captured.
	Battery Low - This icon appears only when the instrument is using a battery pack as the power source. This icon appears when the battery has less than 10 minutes of operating power remaining. The icon turns from yellow to red when instrument shutdown is imminent due to low battery power.

Signal inputs and outputs

Connectors

See the *WFM2200 Installation and Safety Instructions* that shipped with your product for descriptions of the connector functions.

See the *WFM2200 Specifications and Performance Verification Technical Reference* for the complete connector specifications.

Both documents are available in electronic format on the Tektronix Web site at www.tektronix.com/downloads.

Signal inputs

SDI signals   Connect one or more 3G-SDI, HD-SDI, or SD-SDI signals to the SDI inputs on the top panel of the instrument. (See page 14, *Video system installation*.)

Use the CONFIG menu to set the parameters for monitoring the signals, such as thresholds, alarms monitored, and audio source.

External reference signals   The reference input is internally terminated in 75 Ω. Reference signals can be analog video Black Burst or Tri-level sync.

After you connect the appropriate reference signal to the EXT REF connector, press the **EXT REF** button to change the signal reference to external. The EXT button illuminates when External reference is selected. (See page 14, *Video system installation*.)

You can select which signal format to lock to by pressing the **CONFIG** button and selecting **External Ref**. The default setting is Auto.

View the reference signal.   You can use the waveform display to view the signal connected to the EXT REF connector. Press the **WFM** button to open the waveform display pop-up menu, and then select **Display Type > Ref Waveform**.

Genlock function.   You can enable the SDI output test signal to genlock to the external reference signal by pressing the **CONFIG** button and selecting **Outputs > Test Signal Genlock > Enable**. You can also use the CONFIG menu to set the vertical and horizontal timing offsets used by the genlock function. The genlock status icon in the Status Bar indicates the genlock status. (See page 35, *Status bar*.)

Dual link signals   The inputs for dual link signals are the same as for SDI signals. Dual Link monitoring allows you to set up your instrument to monitor higher resolution signals than can be monitored using the traditional single link input. Dual link signals are combined in the instrument and then shown as a single signal on a waveform or other display.

The instrument will automatically detect properly formatted dual link signals which contain a SMPTE352 VPID in both links as required by SMPTE 372. In this case, set the format, structure, and transport settings in the CONFIG > SDI Input submenu to Auto to enable automatic detection of dual link signals.

If the SMPTE352 VPID is missing, the instrument may be forced into dual link input mode by manually selecting the appropriate sample structure and transport settings in the CONFIG > SDI Input submenu. Use the Video Session display (**STATUS > Display Type > Video Session**) to verify proper configuration.

Alpha Channel information is visible if present and is available in RGB and YCbCr display modes, but not in YRGB mode. The following figure is an example of how the signal components appear.

Figure 7: Placement of dual link information in the Waveform display

Connector configuration

After you have connected a signal source to your instrument, there are several menus to use to set up your signal:

■ **CONFIG > SDI Input**: select how SDI inputs are displayed. The instrument can automatically detect the input format, sample structure, and SDI transport type (or you can specify these manually).

You can also choose to not display the EAV, SAV, and ANC data; set chroma alignment; select the NTSC setup level; select HD colorimetry; and set the dual link threshold.

■ Input **A** and Input **B**: press the Input A or Input B button to view the video signal connected to the SDI A or SDI B input connector. The button for the selected input (A or B) is illuminated.

When Option 3G is installed and you are monitoring a 2xHD 3 Gb/s SDI signal (as defined by SMPTE 425), you can press and hold the associated input button to open a pop-up menu where you can select which stream in the signal to monitor. Possible menu options include the following:

  ‐ Input 1A (or Input 1B): displays both of the streams in the 2xHD signal.

  ‐ Input 1A.1 (or Input 1B.1): displays the first stream in the 2xHD signal.

  ‐ Input 1A.2 (or Input 1B.2): displays the second stream in the 2xHD signal.

■ **CONFIG > External Reference**: select how the external reference signal is detected. The instrument can automatically detect the input format or you can specify which format you want detected.

■ **CONFIG > Outputs** and **GEN** pop-up menu:

  ‐ For the SDI video output, select the signal type and format, enable moving picture and moving circle modes, enable genlock and configure the genlock offsets, and enable embedded audio groups. Option 3G is required to generate 3 Gb/s SDI signals.

  ‐ For the AES audio output and for the embedded audio in the SDI video output, select the frequency, amplitude, and bitdepth.

■ **CONFIG > Audio Inputs/Outputs** : select the embedded audio signal channel, format, and mapping, and set the volume for the instrument speakers and headphone output.

Signal outputs

SDI video output   This instrument can generate SD-SDI and HD-SDI signals using the SDI OUT connector. With Option 3G installed, it can also generate a 3 Gb/s SDI test signal.

Three types of signals can be generated in Level A and Level B:

- 75% bars
- 100% bars
- Pathological

For more information about these signals, see the appropriate SMPTE standard.

The following illustration shows signal connections for testing a device. (See Figure 8.) After you connect the signals, use **CONFIG > Outputs** submenu or the **GEN** pop-up menu to select the test signal pattern, level, and format you want to generate.
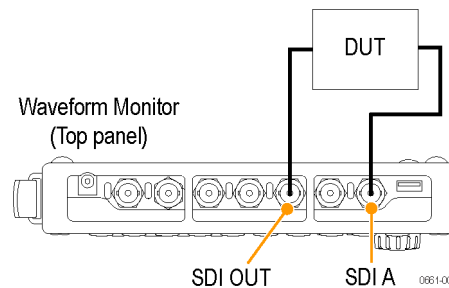
Figure 8: Video signal generation connection

Genlock function.   You can enable the SDI output signal to genlock to the external reference signal by pressing the **CONFIG** button and selecting **Outputs > Test Signal Genlock > Enable**. You can also use the CONFIG menu to set the vertical and horizontal timing offsets used by the genlock function. The genlock status icon in the Status Bar indicates the genlock status. (See page 35, *Status bar*.)

AES audio output   This instrument can generate the following AES audio signals:

■   Test signal: AES test tones with user-configurable frequency, amplitude, and bitdepth.

■   AES loopout: loopthrough output of the signal on the AES IN connector.

■   Audio output: output of the embedded audio in the video signal being output on the SDI OUT connector.

The following illustration shows signal connections for testing a device. (See Figure 9.) After you connect the signals, use **CONFIG > Outputs** submenu or the **GEN** pop-up menu to select the AES audio signal type that you want to generate.
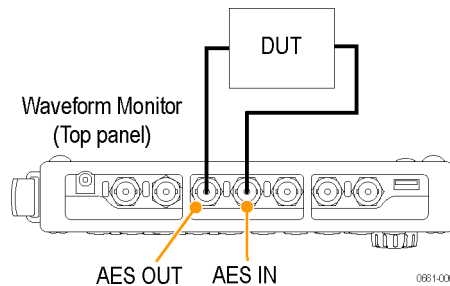
Figure 9: AES audio signal generation connection

Display modes

This section describes each of the available display modes. The displays are listed in alphabetical order:

- *ANC Data display (Option DATA only)* – (See page 44.)

- *Arrowhead display* – (See page 48.)

- *Audio display* – (See page 50.)

- *Bowtie display* – (See page 56.)

- *Datalist display (Option DATA only)* – (See page 58.)

- *Diamond display* – (See page 65.)

- *External Reference Waveform display* – (See page 67.)

- *Generator Status display* – (See page 69.)

- *Lightning display* – (See page 74.)

- *LTC Waveform display* – (See page 77.)

- *Picture display* – (See page 79.)

- *Split Diamond display* – (See page 82.)

- Status displays:

  - *AES Channel Status display* – (See page 85.)

  - *Alarm Status display* – (See page 87.)

  - *ARIB status displays* – (See page 88.)

  - *Audio Control status display* – (See page 89.)

  - *Audio Session status display* – (See page 92.)

  - *Auxiliary Data Status display* – (See page 95.)

  - *Dolby Status display* – (See page 97.)

  - *Error Log status display* – (See page 99.)

  - *Video Session status display* – (See page 102.)

- *Timing display* – (See page 106.)

- *Vector display* – (See page 110.)

- *Waveform display* – (See page 114.)

ANC Data display (Option DATA only)

The ANC (Ancillary) Data display is available only on instruments with Option DATA installed. This display allows you to more closely examine all of the ANC data in a signal.

The ANC Data Inspector is part of the ANC Data display. This ancillary monitoring feature allows you to see all ancillary data present in a signal. The instrument continually monitors the signal and tells you when changes in the presence of data occur.

When Watch List mode is activated, the instrument displays the presence and status of ANC data types you have selected in the Watch List. This allows you to focus on the ANC data types that are important to you.

To access the ANC Data display

1. Press and hold the **MEAS** button to open the Measure pop-up menu.

2. Use the arrow keys to select **Display Type > ANC Data DISP.**.

3. Press the **MEAS** button to close the pop-up menu.

Elements of the ANC Data display

Figure 10: ANC Data display (full screen mode)

The ANC Data display includes two sections: (See Figure 19.)

- **ANC Data Inspector** - This section of the display appears both in quad-tile and full screen display modes. Select a data type in this section to view the user data in the Detail section.

- **Detail** - This section of the display appears only in full screen mode and shows the user data for the data type selected in the ANC Data Inspector. You can expand the Detail area to show more data by pressing the MAG button.

The following information is available on the ANC Data display in full screen mode:

- **DID**: Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.

- **Type**: Type of the ANC Data packet; either Type 1 packet (DID greater than or equal to 0x80), or Type 2 packet (DID less than 0x80), as defined by SMPTE 291M; Type 1 packets do not have a SDID field, instead they have a DBN field; the "actual value" (with parity bits added) is displayed in parentheses.

- **SDID**: Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive; this field only appears when a Type 2 packet is selected; the "actual value" (with parity bits added) is displayed in parentheses (mutually exclusive with DBN field).

- **DBN**: Data Block Number of the acquired packet; values range from 0 to 0xFF; the "actual value" (with parity bits added) is displayed in parenthesis (mutually exclusive with SDID field).

- **DC**: Data Count word of the acquired packet; the number of User Data words is displayed in decimal; the "actual value" (with parity bits added) is displayed in parenthesis, in hexadecimal.

- **Field**: The field of the video from which the packet was acquired; for progressive formats, 1 is displayed.

- **Line**: The line of the video (within the field) from which the packet was acquired.

- **Stream**: For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams; for SD, "N/A" is displayed.

- **Status**: Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

- **Checksum**: Indicates the checksum word that was recovered from the acquired packet.

- **Should be**: Indicates the checksum work computed by the instrument, based on data of the packet.

- **Format**: Indicates the name of the ancillary data type or standard.

- **User Data Words**: Contains the payload of the ancillary packet, displayed in hexadecimal; all 10 bits are displayed.

Measure pop-up menu (ANC Data display)

Press and hold the MEAS button to open the Measure pop-up menu. The pop-up menu enables you to configure the display type and configure display parameters for the different display types. The following menu selections are available:

Display type.   Select from the following display types:

- **Timing** - Displays a Tektronix proprietary view that enables you to easily compare and correct the timing between two signals. (See page 106, *Timing Measure display*.)

- **Datalist (Option DATA only)** - Displays the content of all digital signal formats, structures, and transports (SD, HD, 3G, dual link, 4:2:2, 4:4:4, and others) except for composite signals. (See page 58, *Datalist display (Option DATA only)*.)

- **Bowtie** - Displays the interchannel timing between Y Pb and Y Pr. (See page 56, *Bowtie display*.)

- **ANC Data (Option DATA only)** - Displays all of the ANC data in a video signal.

All sessions reset.   Select this option and press the SEL button to globally reset all of the displayed ANC Data display sessions. The session time is set to zero and all errors (if present) are reset.

View mode.   Select the view mode:

- **All** - Displays all of the ANC data types present in the video signal.

- **Watch list** - Displays only the ANC data types selected by the user in the Watch List. (See page 47, *To configure the Watch List*.)

CONFIG menu   Use the CONFIG menu to set the following ANC Data display parameters:

- Use the **ANC Data Display > User ANC Types** settings to define the ANC data types by name and DID/SDID values.

- Use the **ANC Data Display > Config Watch List** selection to select which ANC data types will be displayed. (See page 47, *To configure the Watch List*.)

- Use the **Aux Data Settings** selections to define the ANC data types by name and DID/SDID values.

- Use the menu selections under **Alarms** to enable the alarms for various types of ANC data errors.

To configure the Watch List   The Watch List allows you to limit the data types viewed in the ANC Data display to only the types you specify. To configure the Watch List, perform the following steps:

1. Press the **CONFIG** button and select **ANC Data Display**.

2. Select **Config Watch List** from the menu.

3. Press the **SEL** button and a table of data types appears.

4. Check the boxes next to the data types you want to view in the ANC Data Inspector. Use the SELECT ALL and CLEAR ALL boxes to quickly select or clear all data types.

5. When you are finished selecting the data types, navigate to the **Return** box and press the **SEL** button.

6. Press the **CONFIG** button to dismiss the menu.

7. Press and hold the **MEAS** button and select **Display Type** and then **ANC Data Display** from the pop-up menu.

You can now view the data types you checked in the Watch List.

Arrowhead display

The Arrowhead display is a Tektronix proprietary display that shows gamut violations of the SDI input if translated into the Composite domain (NTSC and PAL). For more information about using the gamut-checking displays:

■ See *Diamond display* (See page 65.)

■ See *Split Diamond display* (See page 82.)

■ See *Checking gamut* (See page 145.)

■ See the *Preventing Illegal Colors* application note available on the Tektronix Web site (www.tektronix.com)

To access the Arrowhead display

1. Press and hold the **GAMUT** button to open the Gamut pop-up menu.

2. Use the arrow keys to select **Display Type > Arrowhead**.

3. Press the **GAMUT** button to close the pop-up menu.

Elements of the Arrowhead display
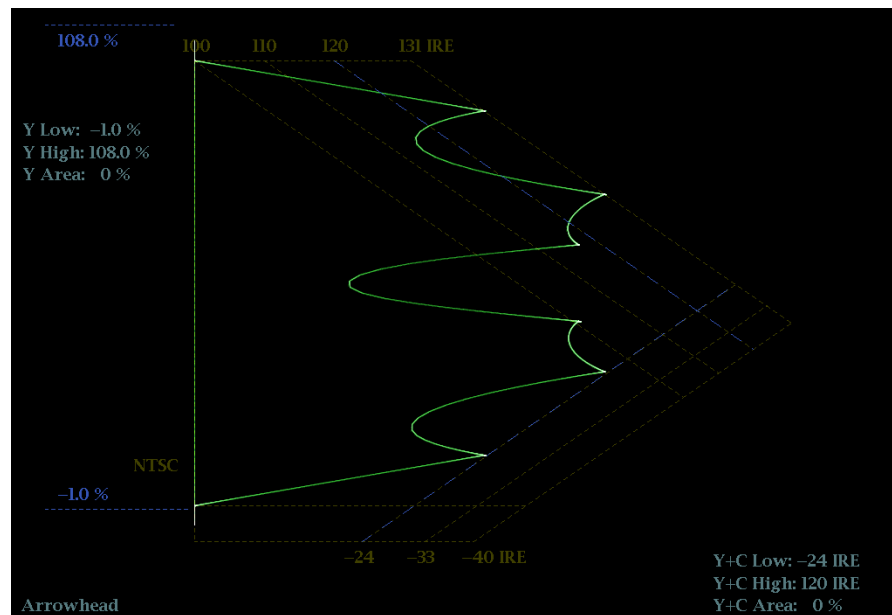
Figure 11: Arrowhead display

■ **High threshold:** Shows the currently specified high threshold (Arrowhead NTSC Max or Arrowhead PAL Max) setting in the CONFIG > Gamut Thresholds menu.

■ **Low threshold:** Shows the currently specified low threshold (Arrowhead NTSC Min or Arrowhead PAL Min) setting in the CONFIG > Gamut Thresholds menu.

- **Gamut display type:** Shows the selected Gamut display type - Arrowhead, Diamond, or Split Diamond.

- **Threshold indicators:** Indicates the threshold settings using blue dashed lines.

- **Luma minimum:** Shows the currently specified minimum luma threshold (Luma Min) setting in the CONFIG > Gamut Thresholds menu.

- **Luma maximum:** Shows the currently specified maximum luma threshold (Luma Max) setting in the CONFIG > Gamut Thresholds menu.

- **Y Area** and **Y+C Area:** Shows the specified percentage of the total image pixels that can be outside the current luma (Y) and gamut (Y+C) limits and not generate error reports.

- **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Gamut pop-up menu (Arrowhead display)

Press and hold the GAMUT button to open the Gamut pop-up menu. The pop-up menu enables you to select the from the following Tektronix proprietary gamut displays:

- **Arrowhead** - Displays gamut violations of the SDI input if translated into the Composite domain (NTSC and PAL).

- **Diamond** - Displays gamut violations of the SDI input if translated to the RGB color space. (See page 65, *Diamond display*.)

- **Split Diamond** - Like the Diamond display, displays gamut violations of the SDI input if translated to the RGB color space. However, the Split Diamond display offsets the two halves of the Diamond display to allow you to better see negative RGB gamut errors. (See page 82, *Split Diamond display*.)

CONFIG menu

Use the CONFIG menu to set the following Arrowhead display parameters:

- Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports, and reset the gamut and luma limits to default values.

- Use the menu selections under **Alarms > Video Content** to enable the alarms for the Arrowhead display.

- Set the **Graticules & Readouts > Gamut Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

Audio display

The Audio display provides level meters and a phase display for monitoring audio signals. The level meters and correlation meters are always shown. When you choose to show the Phase plot (also known as Lissajous) or Surround Sound displays, the left part of the Audio tile displays the level meters and the right part the Phase or Surround Sound display. (See Figure 12.)

To access the Audio display

1. Press and hold the **AUDIO** button to open the Audio pop-up menu.

2. Use the arrow keys to select the AUX display mode:

   - **Off** - Turns off the auxiliary display (Phase or Surround), which allows the level meters to occupy the complete viewing area.

   - **Phase display** - Displays a plot of the audio phase in either 2-channel XY or Lissajous Sound Stage modes.

   - **Surround display** - Displays a plot of the channel levels in a surround-sound listening environment.

3. Press the **AUDIO** button to close the pop-up menu.

Elements of the Audio display
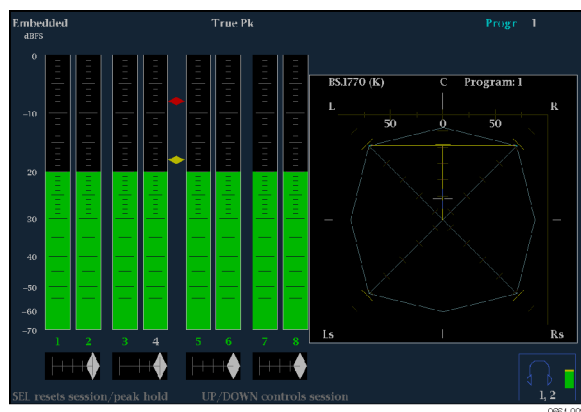
Figure 12: Audio display (Surround mode)

- **Level meters**: Shows the audio levels. (See page 168, *To check audio level*.) The response of the level meters is determined by the ballistics setting in the CONFIG > Digital Audio Displays menu.

- **Phase or Surround Display**: Select between the Phase display, where the phase of a selected pair of channels is plotted against an X-Y or sound-stage plot, and the Surround display, where all the channels' levels display in positions matching their place in a surround-sound listening environment. (See page 169, *To check audio phase*.) (See page 174, *Elements of the Surround Sound display*.)

- **Audio source/setup**: Displays the selected audio input and related setup information, such as Listening Mode when in Surround display. (See page 167, *Audio monitoring*.)

- **Level meter labels**: Identifies the signal in each meter bar. The labels vary according to whether the audio sources to the level meter bars are normal channel pairs, surround channels, or Dolby sources (the Dolby source labels include Dolby type).

- **Level meter ballistics readouts**: Displays the selected dynamic response characteristic.

- **Axes**: Shows the orientation of the two audio signals when displaying phase; shows the orientation and amplitudes of the sound field when displaying surround sound. (Axes are selectable for an X-Y or Soundstage plot.)

- **Phase correlation meters**: Displays the phase correlation between the two-channel bars under which it appears. The meter of the pair selected for the Phase display also appears in the Phase display. (See page 169, *To check audio phase*.)

- **Test level and Peak program level indicators**: Diamond-shaped markers between the level bars indicate the configurable limits set up for the display. Above the Test level, the bar displays in a yellow color. Above the Peak level, the bar displays in a red color. Test level is also known as Reference level or Line-up level.

- **Level meter scale and units**: By default, the units are in dB relative to full scale (dBFS) for digital inputs and dB relative to 0.775 Volts (dBu) for analog inputs. The 0 dB mark is digital Full scale for digital inputs and 0 dBu for analog inputs. You may also set the 0 dB mark to either the Peak Program level or the Test level.

Above-bar warning messages

This instrument displays warning messages above the level meter bars. The warning messages that can appear above the bars as follows:

- **Clip**. The number of consecutive samples equals or exceeds the # Samples for Clip setting.

- **Over**. The signal is at or above the specified Over Level for a time exceeding the Duration for Over setting.

In-bar warning messages

This instrument displays warning messages within the level meter bars. The warning messages that can appear are shown below in order of priority.

■ **UNLOCKED**. The instrument is not locked to an incoming signal on the indicated input channel. Data cannot be decoded and all data and other errors are ignored. This means that if an AES input is selected, nothing recognizable is present on the input, or if embedded audio is selected, the VIDEO input is unrecognizable.

■ **AES PARITY.** The incoming subframe does not have even parity as specified by the digital audio standards. The data sample is unreliable and is ignored. The level meters and Lissajous display treat the sample as a zero sample.

■ **AES CRC ERROR.** The CRC code in the AES channel status packet is incorrect. Sometimes the CRC code is set to zero, indicating that the signal is missing; when this is the case, this message is not displayed.

■ **MUTE.** The number of consecutive all-zero samples equals or exceeds the # Samples for Mute setting.

■ **SILENCE.** The signal is at or below the specified Silence Level for a time exceeding the Duration for Silence setting.

■ **DISABLED.** Indicates that an audio bar is not active.

■ **AES V BIT.** Indicates that the Validity bit is set high for one or more data samples. In the AES/EBU standard, a set Validity bit indicates that the sample is not suitable for conversion to audio.

When the Ignore Validity Bit setting is set to On in the CONFIG > Digital Audio Displays submenu (the default value), the Validity bit is ignored and the audio sample as treated as normal audio. When the Ignore Validity Bit setting is set to Off, then the Validity bit value is used to mute the audio when the bit value is high.

■ **NO AUDIO.** Indicates that an AES or embedded input has the Non audio bit set.

■ **NOT PRESENT.** Indicates that an audio channel is not present in the current audio input.

■ **DOLBY D.** Indicates an AES or embedded input is DOLBY Digital (not plus).

■ **DOLBY D+.** Indicates an AES or embedded input is DOLBY Digital Plus.

■ **DOLBY E.** Indicates an AES or embedded input is DOLBY E.

Audio pop-up menu Press and hold the AUDIO button to open the Audio pop-up menu. The Audio pop-up menu enables you to select the audio input source and specify whether one of the auxiliary displays (audio phase or surround-sound) appears to the right of the level meter display. Some of the menu selections depend on the selected audio input source and which auxiliary display is enabled.

Audio input. When you select one of the following audio input sources other than Follows Video, the Audio display monitors the selected input regardless of which video input is active.

NOTE. Use the CONFIG menu to select the mapping of audio input channels to level bars, the meter type, and the Follows Video mapping of audio to video.

- **Follows Video** - Sets the audio source to be from the audio source configured for selected video input in the CONFIG > Audio Inputs/Outputs > Video to Audio Map submenu. If you select a different video input, the audio source then changes to the audio source configured for that video input.

- **AES A** - Sets the audio source to be from the AES audio input.

- **Embedded** - Sets the audio source to be from the embedded audio on the currently selected video input. Select which eight audio channels are shown in the level meters by configuring the Bar to Input Map settings in the CONFIG > Audio Inputs/Outputs submenus for the Embedded A, Embedded B, or Embedded Dual Link selections.

- **Emb. 16-Ch** - Sets the audio source to be from the embedded audio on the currently selected video input. This mode displays level meters for all 16 channels in the embedded audio, but does not display the correlation meters nor the Phase or Surround Sound auxiliary displays.

NOTE. When the audio input source is set to Emb. 16-Ch, Emb. 1-8, or Emb. 9-16, you can use the left/right arrow keys to quickly toggle through these three audio input sources.

- **Emb. 1-8** - Sets the audio source to be from the first eight channels in the embedded audio on the currently selected video input. This mode displays the correlation meters for the first eight channels and displays the Phase or Surround Sound auxiliary displays when they are enabled.

- **Emb. 9-16** - Sets the audio source to be from the second eight channels in the embedded audio on the currently selected video input. This mode displays the correlation meters for the second eight channels and displays the Phase or Surround Sound auxiliary displays when they are enabled.

Auxiliary display. Select from the following auxiliary displays:

■ **Off** - Disables the auxiliary display, which allows the level meters to occupy the complete viewing area in the Audio display.

■ **Phase Display** - Sets the auxiliary display to show a 2-channel phase display. A phase display is also called a Lissajous display. Use the Phase Style menu selection to choose the plot style of the phase display.

■ **Surround Dp.** - Sets the auxiliary display to show a multichannel surround sound display. Use the Dominance Indicator menu selection to turn the dominance indicator on and off.

NOTE. The Audio Surround Sound display is courtesy of Radio-Technische Werkstaetten GmbH & Co. KG (RTW) of Cologne, Germany.

Phase style. When Phase Display is selected as the auxiliary display, you can select from the following display styles:

■ **Liss Snd Stage** - Displays the L and R axes rotated at 45 degrees in the Lissajous Sound Stage style.

■ **X-Y** - Displays the L and R axes in the vertical and horizontal positions respectively.

Dominance indicator. When Surround Display is selected as the auxiliary display, use this menu selection to turn the dominance indicator on and off. When on, it indicates the location of the dominant sound in the surround sound image using a cross-hairs pointer.

Phase/Headphone pair. Select which audio pairs are mapped to the headphone jack and to the phase display. When you select **Custom**, you can specify individual channels for the input pair using the Custom Phase A and Custom Phase B menu selections.

Audio program. Select which program (1-8) in the embedded audio to monitor. This setting affects the Audio display only under the following conditions:

■ When the bar format for the selected embedded audio source (Embedded A, Embedded B, or Embedded Dual Link) is set to Program (Surround) in the CONFIG > Audio Inputs/Outputs submenu.

■ When the selected surround sound type contains more than one program. The type of surround sound is selected in the CONFIG > Audio Inputs/Outputs > Program Cfg submenu.

CONFIG menu   Use the CONFIG menu to set the following Audio display parameters:

- Use the menu selections under **Digital Audio Displays** to configure various audio display parameters such as meter type, ballistic characteristics, peak program level, meter scaling, alarm thresholds, correlation speed, and turning the Lissajous AGC mode on and off.

- Use the menu selections under **Audio Inputs/Outputs** to configure audio input and output parameters such as selecting which channels are active on each audio input port, selecting how each audio port is displayed, selecting the audio output source, selecting which channels to de-embed from the SDI video, configuring the "map" of active audio for each video input, and adjusting the speaker and headphone volume.

  If Option 3G is installed, 3G Level A signals use the Embedded A or B settings as appropriate. Dual Link and 3G Level B signals use the Embedded Dual Link settings.

- Use the menu selections under **Alarms > Audio Content** and **Alarms > AES/Embedded** to enable various audio alarms.

To adjust audio volume   You can use any of the following methods to adjust the volume of the audio played out on the instrument speakers or the headphone jack:

⚠ *WARNING. To prevent the risk of hearing damage, always turn down the audio volume before connecting headphones to the instrument. Sound levels and impedance can vary between different headphones.*

- When the Audio display is selected and no menus are active, turn the General knob.

- When a display mode other than Audio is selected, press the **VOL** button and then use the General knob or the up/down arrow keys.

- Select the **CONFIG > Audio Inputs/Outputs > Headphone Volume** submenu item and then use the General knob or the up/down arrow keys.

- At any time, press and hold the **VOL** button to toggle audio muting. A red "X" appears over the speaker icon in the Status Bar when audio is muted.

NOTE. When monitoring high-amplitude audio, volume levels over 90% may cause audio clipping.

Bowtie display

The Bowtie display allows you to look at interchannel timing between Y Pb and Y Pr. The left side of the display compares Y and Pb; the right side compares Y and Pr. The Bowtie display requires a test signal with slightly differing frequencies on the chroma channels than on the luma channel.

If the bowtie patterns have a sharp null, and the null is at the center of each line, the relative amplitudes and interchannel timing are correct. Interchannel timing errors will move the position of the null:

- A relative amplitude error will decrease the depth of the null

- An incomplete null combined with an offset from center indicates both amplitude and timing problems between the channels being compared

To access the Bowtie display

1. Press and hold the **MEAS** button to open the Measure pop-up menu.

2. Use the arrow keys to select **Display Type > Bowtie**.

3. Press the **MEAS** button to close the pop-up menu.

Elements of the Bowtie display
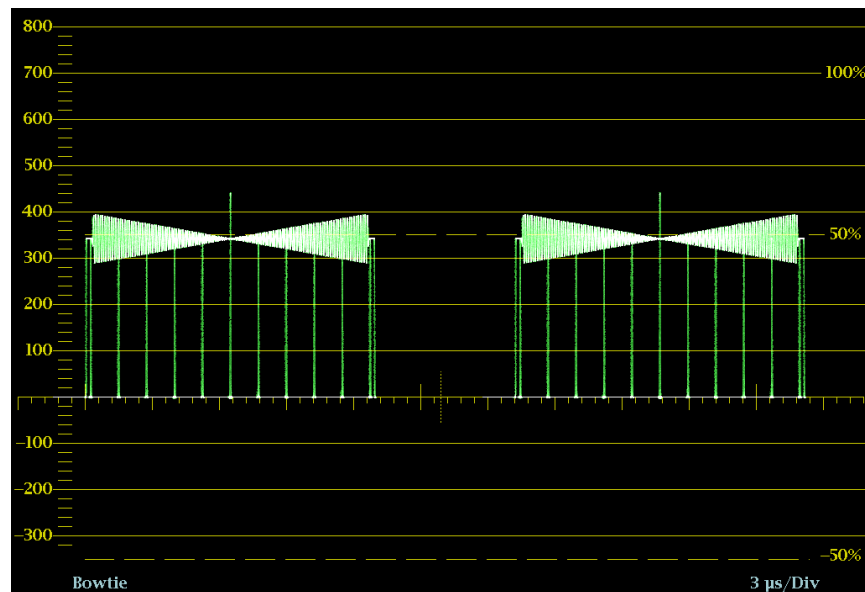
Figure 13: Bowtie display

- **Display**: Shows the display type as Bowtie.

- **Y-axis units**: The units for the y-axis depend on the test signal and the signal format.

- **X-axis units**: Shows the x-axis in microseconds/divisions.

■ **H** and **V** positions: When you press the POS button to adjust the position of the waveform, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

■ **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Measure pop-up menu (Bowtie display)   Press and hold the MEAS button to open the Measure pop-up menu. The pop-up menu enables you to configure the display type and configure display parameters for the different display types. The following menu selections are available:

Display type.   Select from the following display types:

■ **Timing** - Displays a Tektronix proprietary view that enables you to easily compare and correct the timing between two signals. (See page 106, *Timing Measure display*.)

■ **Datalist (Option DATA only)** - Displays the content of all digital signal formats, structures, and transports (SD, HD, 3G, dual link, 4:2:2, 4:4:4, and others) except for composite signals. (See page 58, *Datalist display (Option DATA only)*.)

■ **Bowtie** - Displays the interchannel timing between Y Pb and Y Pr.

■ **ANC Data (Option DATA only)** - Displays all of the ANC data in a video signal. (See page 44, *ANC Data display (Option DATA only)*.)

Parade Overlay.   Select how the waveform appears by selecting **Parade** or **Overlay**.

Center waveform.   Select this option to cancel any horizontal or vertical position adjustments and restore the trace to the default position.

CONFIG menu   Use the CONFIG menu to set the following Bowtie display parameters:

■ Set the **Graticules & Readouts > Waveform Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity, graticule color, and enabling the thumbnail view.

To position the Bowtie trace

To adjust the position of the trace on the Bowtie display:

1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout.

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

Datalist display (Option DATA only)

The Datalist display allows you to see SD, HD, or 3G (Option 3G only) data without any interpolation. The Datalist tool examines the contents of all digital formats, structures, and transports (SD, HD, dual-link, 3 Gb/s, 4:2:2, 4:4:4, and others). Datalist works for all signals except composite signals (analog NTSC and analog PAL). From the display screen, you can select and isolate specific lines and words from the video or data stream.

To access the Datalist display

1. Press and hold the **MEAS** button to open the Measure pop-up menu.

2. Use the arrow keys to select **Display Type > Datalist Display**.

3. Press the **MEAS** button to close the pop-up menu.

Elements of the Datalist display
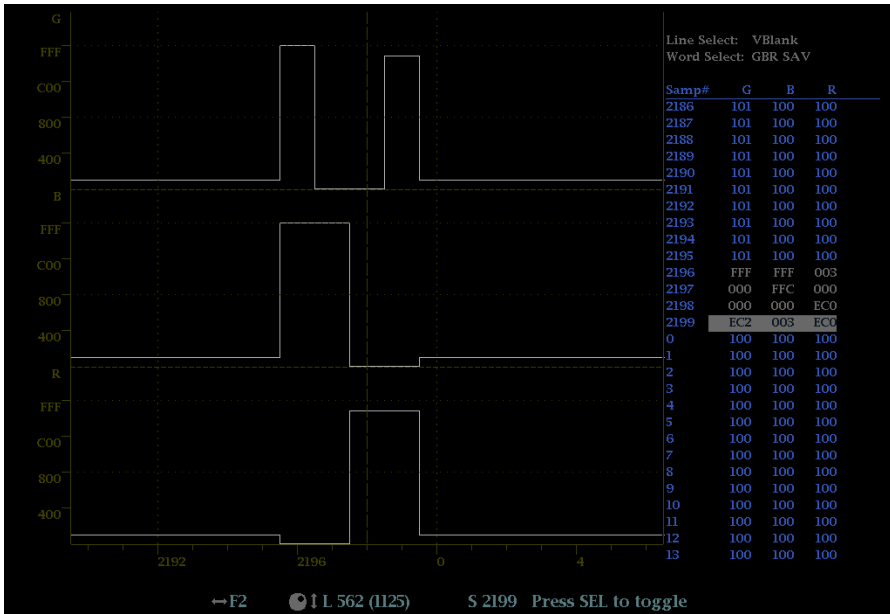
Figure 14: Datalist display

Use the navigation text on the bottom of the display screen to select line and sample items using the arrow keys and the General knob.

- **Line Select**: Shows which line is selected; press the **SEL** button to switch between Line Select and Word Select.

- **Word Select**: Shows which word is selected; press the **SEL** button to switch between Line Select and Word Select.

- **Samp#**: Shows the sample number.

- **Y0, Cb, Cr, Y1**: These labels change based on the signal, but they show the line number for each component.

Datalist color coding   Different fields of the data stream are shown in different colors:

- **Green**: Active video data.

- **Blue**: Data in horizontal or vertical blanking intervals.

- **White**: EAV and SAV packets; other reserved values such as the XYZ word.

- **Yellow**: Data outside the nominal allowed values.

- **Red**: Data with illegal values.

Finding SAV and EAV in the active video stream   From anywhere in the video stream, press the **CURSOR** button once to immediately jump to the EAV of the selected line. Press the button again to jump to the SAV of the same line. This allows you to move quickly to the beginning of the ANC data, which is right after the EAV.

Measure pop-up menu (Datalist display)   Press and hold the MEAS button to open the Measure pop-up menu. The pop-up menu enables you to configure the display type and configure display parameters for the different display types. The following menu selections are available:

Display type.   Select from the following display types:

- **Timing** - Displays a Tektronix proprietary view that enables you to easily compare and correct the timing between two signals. (See page 106, *Timing Measure display*.)

- **Datalist (Option DATA only)** - Displays the content of all digital signal formats, structures, and transports (SD, HD, 3G, dual link, 4:2:2, 4:4:4, and others) except for composite signals.

- **Bowtie** - Displays the interchannel timing between Y Pb and Y Pr. (See page 56, *Bowtie display*.)

- **ANC Data (Option DATA only)** - Displays all of the ANC data in a video signal. (See page 44, *ANC Data display (Option DATA only)*.)

Trace type. Select from the following trace types (Video is the default setting):

■ **Video** - This mode shows the data similar to the video YPbPr display in Waveform mode, but without interpolation. The Y, Cb, and Cr traces are offset vertically to separate them, but are aligned temporally. You can select to turn on or off individual component traces of the display.

■ **Data** - For an SD signal, this mode shows the data in the same sequence as it occurs in the serial domain. You see a sample of Y, then of Cb, then of Y' (Y prime), and then of Cr. Then the sequence repeats. The Y sample is the co-sited sample and the Y' sample is the isolated luma sample.

   For an HD signal, this mode splits the serial input into a Y channel and a multiplexed Cb/Cr channel. The intent is to show the data in the same block structure as it occurs in the serial domain, even though it is displayed as 8 or 10-bit values.

Trace Y, Trace Cb, and Trace Cr. When the Trace Type is set to Video, use these selections to turn on or off the individual component traces of the display.

Format. Set the data format to Hexadecimal, Decimal, or Binary. The default data format is Hexadecimal.

CONFIG menu   Use the CONFIG menu to set the following Datalist display parameters:

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as readout intensity and graticule color.

■ Use the menu selections under **Aux Data Settings** to set various data parameters.

■ Use the menu selections under **Alarms** to enable various alarms that will highlight data as errors.

Diagnostics Monitor display

The Diagnostics Monitor display shows the status of various instrument diagnostics. Use the up and down arrow keys to navigate through the different pages of the display.

To access the Diagnostics Monitor display

1. Press and hold the **GEN** button to open the Generator pop-up menu.

2. Use the arrow keys to select **Display Type > Diag Monitor**.

3. Press the **GEN** button to close the pop-up menu.

Elements of the Diagnostics Monitor display

Elements on all pages. There are four pages to the Diagnostics Monitor display. The following information appears on all pages of the display:

- **Session Start:** Shows the date and time of the instrument when the Diagnostic Monitor session started. This start time applies to all of the pages in the Diagnostics Monitor display.

- **Run Time:** Shows the amount of time that has elapsed since the Diagnostic Monitor session was started. This run time applies to all of the pages in the Diagnostics Monitor display.

Elements on Page 1. The following instrument diagnostic information appears on page 1 of the display: (See Figure 15.)

- **Fan Speed (rpm):** Shows the current speed of both internal fans and the high and low speed measurements for each fan since the instrument was turned on.

- **Temperatures:** Shows the last, low, high, and average temperatures for various internal components.

Elements on Pages 2 and 3. The following instrument diagnostic information appears on pages 2 and 3 of the display: (See Figure 16.) (See Figure 17.)

- **Power Supply Voltages:** Shows the last, low, high, and average power supply voltages for various internal components.

Elements on Page 4. The following instrument diagnostic information appears on page 4 of the display: (See Figure 18.)

- **External Power & Battery Information:** Shows the status of various parameters related to the operation of the battery pack. If a battery pack is not installed in the instrument, the Status readout shows "Not Present" and the diagnostic parameters will list "N/A" as the status.

Figure 15: Diagnostics Monitor display (page 1)

Figure 16: Diagnostics Monitor display (page 2)

Figure 17: Diagnostics Monitor display (page 3)

Figure 18: Diagnostics Monitor display (page 4)

Generator pop-up menu (Generator Status display)

Press and hold the GEN button to open the Generator pop-up menu. The following menu selections are available:

Display Type. Select from the following display types:

- **Generator Status** – Displays the status of both video and audio signals being generated by the instrument. (See page 69, *Generator Status display*.)

- **Diagnostics Monitor** – Displays the status of various instrument diagnostics.

CONFIG menu

The diagnostic information that is viewed from the Diagnostics Monitor displays is different than the diagnostics that are run when the instrument is powered on. You can use the CONFIG menu to view and configure the following Diagnostics Log parameters:

- Use the **Alarms > System and Diagnostics** setting to enable an alarm for a hardware fault.

- Use the menu selection under **Utilities** to run diagnostics, to set how the diagnostics log responds when full, to view the diagnostics log, and to configure custom diagnostics.

Diamond display

The Diamond display is a Tektronix proprietary display that shows gamut violations of the SDI input if translated to the RGB color space. For more information about using the gamut-checking displays:

- See *Arrowhead display* (See page 48.)

- See *Split Diamond display* (See page 82.)

- See *Checking gamut* (See page 145.)

- See the *Preventing Illegal Colors* application note available on the Tektronix Web site (www.tektronix.com)

To access the Diamond display

1. Press and hold the **GAMUT** button to open the Gamut pop-up menu.

2. Use the arrow keys to select **Display Type > Diamond**.

3. Press the **GAMUT** button to close the pop-up menu.

Elements of the Diamond display
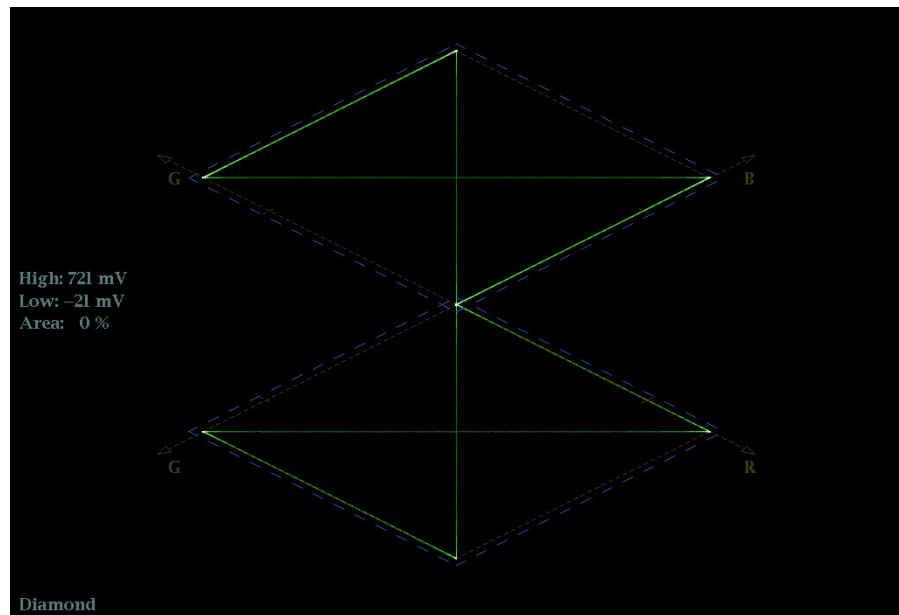
Figure 19: Diamond display

- **High threshold:** Shows the currently specified Diamond High threshold setting in the CONFIG > Gamut Thresholds menu.

- **Low threshold:** Shows the currently specified Diamond Low threshold setting in the CONFIG > Gamut Thresholds menu.

- **Gamut display type:** Shows the selected Gamut display type - Arrowhead, Diamond, or Split Diamond.

■ **Threshold indicators:** Indicates the threshold settings using blue dashed lines.

■ **Y Area:** Shows the specified percentage of the total image pixels that can be outside the current gamut limits and not generate error reports.

■ **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Gamut pop-up menu (Diamond display)

Press and hold the GAMUT button to open the Gamut pop-up menu. The pop-up menu enables you to select the from the following Tektronix proprietary gamut displays:

■ **Arrowhead** - Displays gamut violations of the SDI input if translated into the Composite domain (NTSC and PAL). (See page 48, *Arrowhead display*.)

■ **Diamond** - Displays gamut violations of the SDI input if translated to the RGB color space.

■ **Split Diamond** - Like the Diamond display, displays gamut violations of the SDI input if translated to the RGB color space. However, the Split Diamond display offsets the two halves of the Diamond display to allow you to better see negative RGB gamut errors. (See page 82, *Split Diamond display*.)

CONFIG menu

Use the CONFIG menu to set the following Diamond display parameters:

■ Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports, and reset the gamut and luma limits to default values.

■ Use the menu selections under **Alarms > Video Content** to enable the alarms for the Diamond display.

■ Set the **Graticules & Readouts > Gamut Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

External Reference Waveform display

The External Reference Waveform display allows you to check the integrity of the reference signal on the EXT REF connector, including its shape and amplitude. This display is independent of the input video signal. (See Figure 20.)

To access the External Reference Waveform display

1. Press and hold the **WFM** button to open the Waveform pop-up menu.

2. Use the arrow keys to select **Display Type > Ref Waveform**.

3. Press the **WFM** button to close the pop-up menu.

Elements of the External Reference Waveform display
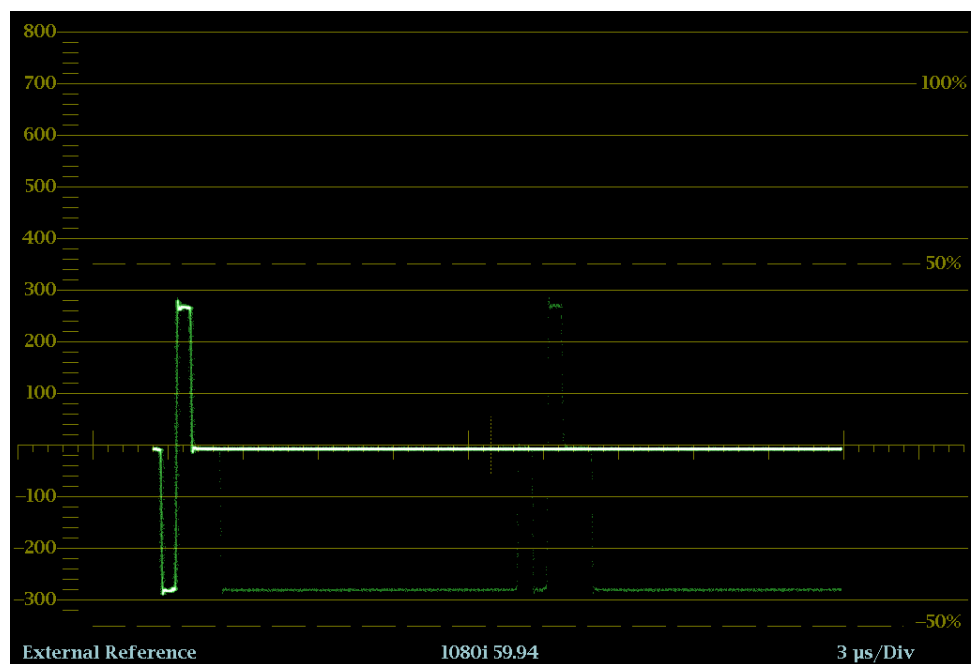
Figure 20: External Reference Waveform display (tri-level sync signal)

■ **Display**: Shows the display type as External Reference.

■ **Y-axis units**: Shows the y-axis units in millivolts per division.

■ **X-axis units**: Shows the x-axis in milliseconds or microseconds per division depending on the sweep setting.

■ **V Gain**: When you press the GAIN or VAR buttons to change the gain setting, a V Gain readout appears.

■ **H** and **V** positions: When you press the POS button to adjust the position of the waveform, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

Waveform pop-up menu (External Reference Waveform display)

Press and hold the WFM button to open the Waveform pop-up menu. The pop-up menu enables you to configure the display type and to center the waveform. The following menu selections are available:

Display type. Select from the following display types:

- **Waveform** - Displays a voltage versus time plot of the selected SDI input signal (SDI A or SDI B). (See page 114, *Waveform display*.)

- **LTC Waveform** - Displays a voltage versus time plot of the LTC input signal (LTC IN). (See page 77, *LTC Waveform display*.)

- **Ref Waveform** - Displays a voltage versus time plot of the external reference input signal (REF IN).

Center waveform. Select this option to cancel any horizontal or vertical position adjustments and restore the trace to the default position. This puts the baseline at the zero graticule.

CONFIG menu

Use the CONFIG menu to set the following External Reference Waveform display parameters:

- Set the **External Reference > Lock to Format** setting to **Auto** or select the expected format from the list.

- Set the **Alarms > Reference Input** settings as desired.

- Set the **Graticules & Readouts > SDI Waveform Graticules** setting to **Normal** or **Percent** to set the measurement units for the vertical axis.

- Set the **Graticules & Readouts > Waveform Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

To position the External Reference Waveform trace

To adjust the position of the trace on the External Reference Waveform display:

1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout.

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

Generator Status display

The Generator Status display shows the status of both video and audio signals being generated by the instrument.

To access the Generator Status display

1. Press and hold the **GEN** button to open the Generator pop-up menu.

2. Use the arrow keys to select **Display Type > Generator Status**.

3. Press the **GEN** button to close the pop-up menu.

Elements of the Generator Status display
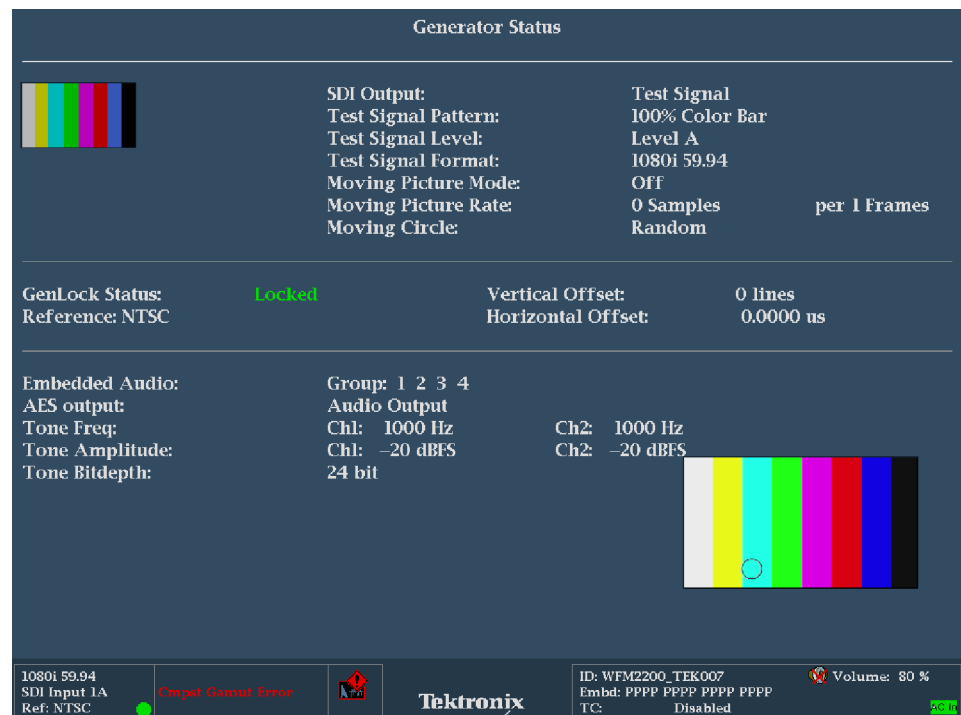
Figure 21: Generator Status display

The following video signal generator status elements appear on the display:

- **Thumbnail picture:** Shows a thumbnail display of the picture generated by the output signal of the video generator.

- **SDI Output:** Shows whether the SDI output is set to be a test signal or a loopout of the selected SDI video input.

- **Test Signal Pattern:** Shows which test signal will be output when the SDI Output setting is Test Signal.

- **Test Signal Level:** Shows the signal level (A or B) that will be output when the SDI Output setting is Test Signal.

- ■ **Test Signal Format:** Shows the signal format that will be output when the SDI Output setting is Test Signal.

- ■ **Moving Picture Mode:** Shows whether the Moving Picture mode is turned on or off.

- ■ **Moving Picture Rate:** Shows the frame and sample rate settings for the Moving Picture mode.

- ■ **Moving Circle:** Shows the current setting for the Moving Circle function (Off, Horizontal, Vertical, or Random).

The following genlock status elements appear on the display:

- ■ **Genlock Status:** Shows the current status of the genlock function (Disable, Locked, or Unlocked).

- ■ **Reference:** Shows the format of the external reference signal being used for the genlock function. Ext Missing is displayed when no external reference signal is detected.

- ■ **Vertical Offset:** Shows the amount of offset (in video lines of the configured generator test signal video format) for the vertical timing of the output signal relative to the external reference signal.

- ■ **Horizontal Offset:** Shows the amount of offset (in microseconds) for the horizontal timing of the output signal relative to the external reference signal.

The following audio signal generator status elements appear on the display:

- ■ **Embedded Audio:** Shows which embedded audio groups are turned on in the video signal output when the SDI Output setting is Test Signal.

- ■ **AES Output:** Shows whether the AES output is turned off, is set to be a test tone signal, or is set to be a loopout of the AES input signal or the embedded audio from the selected video input.

- ■ **Tone Frequency:** Shows the test tone audio frequencies for channel 1 and channel 2 when the AES Output setting is Test Tone.

- ■ **Tone Amplitude:** Shows the test tone audio amplitudes for channel 1 and channel 2 when the AES Output setting is Test Tone.

- ■ **Tone Bitdepth:** Shows the test tone audio bitdepth (20 bit or 24 bit) when the AES Output setting is Test Tone.

NOTE. The above tone frequency, amplitude, and bitdepth settings are used in both the AES audio output and in the embedded audio of the SDI video output. The same audio channel pair is duplicated to all pairs of embedded audio.

Generator pop-up menu (Generator Status display)

Press and hold the GEN button to open the Generator pop-up menu. The pop-up menu provides a shortcut to the same settings controlled in the CONFIG > Outputs menu. The following menu selections are available:

Display Type. Select from the following display types:

- **Generator Status** – Displays the status of both video and audio signals being generated by the instrument.

- **Diagnostics Monitor** – Displays the status of various instrument diagnostics. (See page 61, *Diagnostics Monitor display*.)

SDI Output. Sets the SDI video output to be a test signal or a loopout of the selected SDI video input.

Signal Pattern. When the SDI Output setting is Test Signal, selects the signal to be output (100% Color Bar, 75% Color Bar, or Pathological Signal).

Signal Level. When the SDI Output setting is Test Signal, selects the level of the output signal (Level A or Level B).

Signal Format. When the SDI Output setting is Test Signal, selects the format of the output signal.

Genlock. Enables or disables whether the generator signal output is genlocked to the external reference input signal.

Genlock Offset V. Sets the amount of offset (in video lines of the configured generator test signal video format) for the vertical timing of the output test signal relative to the external reference signal.

Genlock Offset H. Sets the amount of offset (in microseconds) for the horizontal timing of the output test signal relative to the external reference signal.

Moving Picture. When the SDI Output setting is Test Signal, turns the Moving Picture mode on and off.

NOTE. The Moving Picture and the Moving Circle functions are mutually exclusive. Only one of these functions can be enabled at a time. For example, if you enable Moving Picture when Moving Circle is already enabled, Moving Circle is turned off automatically when Moving Picture is enabled.

Per Frames. When the SDI Output setting is Test Signal and the Moving Picture mode is on, sets the frame rate for the moving picture.

Moving Samples. When the SDI Output setting is Test Signal and the Moving Picture mode is on, sets the sample rate for the moving picture.

Moving Circle. Enables or disables the Moving Circle function on the generator signal output. When enabled, you can set the motion of the circle to be Horizontal, Vertical, or Random. The Moving Picture and the Moving Circle functions are mutually exclusive. See the *Note* above for the Moving Picture selection.

NOTE. The moving circle allows you to easily identify whether the test signal is active "live" or still and helps determine problems within the signal path that has been caused by equipment freezing on the last frame.

Figure 22: Picture display showing Moving Circle enabled on the SDI output

Embedded Audio. When the SDI Output setting is Test Signal, selects which embedded audio groups are enabled in the video output signal (groups 1 through 4).

AES Output. Sets the AES audio output to be off, a test tone signal, a loopout of the AES audio input, or a loopout of the embedded audio from the selected video input signal.

Audio Frequency. When the AES Output setting is Test Signal, sets the frequency of the test tone output for channels 1 and 2.

Audio Amplitude. When the AES Output setting is Test Signal, sets the amplitude of the test tone output for channels 1 and 2.

Audio Bitdepth. When the AES Output setting is Test Signal, sets the bitdepth of the test tone output to 20 bit or 24 bit.

CONFIG menu   The settings controlled in the Generator Status pop-up menu are duplicated in the CONFIG > Outputs menu. Changes made in the Generator Status pop-up menu immediately appear in the CONFIG > Outputs menu selections.

Lightning display

The Lightning display is a Tektronix proprietary display that plots the Pr and Pb signals against luminance. As shown below, Y versus Pb is plotted in the top half of the display and Y versus Pr is plotted in the bottom half.
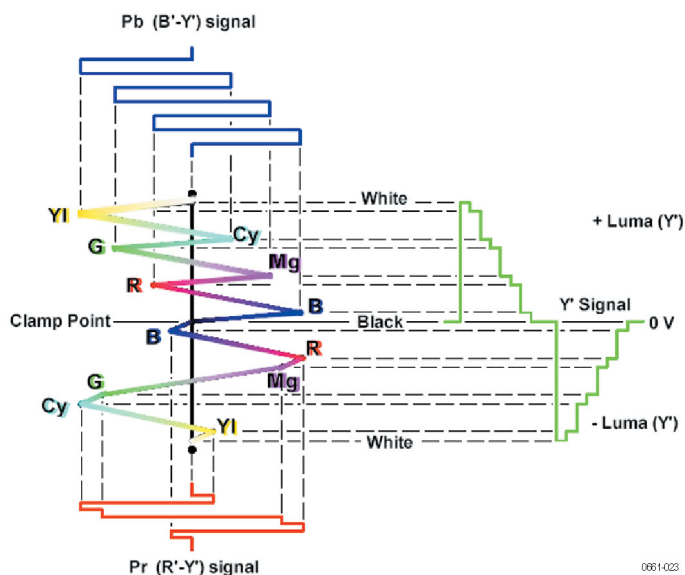
Figure 23: Construction of the Lightning display

This display is useful for checking chroma and luma gain, and for checking chroma to luma delay using the timing marks that show errors in the green to magenta transition on a color bar signal.

You can set the color bar targets to 75% or 100% and center the trace within the tile.

The related Vector display plots the Pr signal on the vertical axis and the Pb signal on the horizontal axis, which is useful for looking at hue and amplitude of the colors, but does not show luminance information. (See page 110, *Vector display*.)

To access the Lightning display

1. Press and hold the **VECTOR** button to open the Vector pop-up menu.

2. Use the arrow keys to select **Display Type > Lightning**.

3. Press the **VECTOR** button to close the pop-up menu.

Elements of the Lightning display
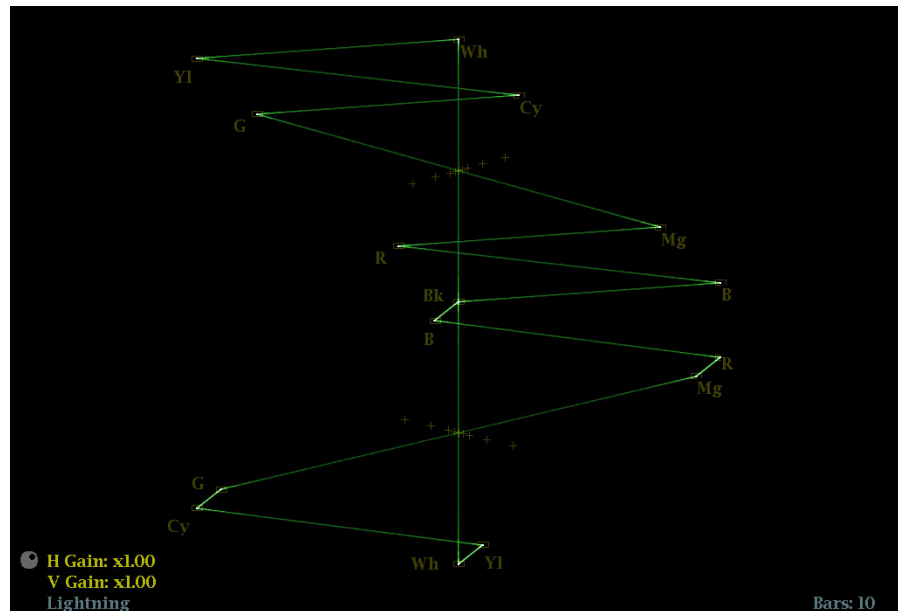
Figure 24: Lightning display

The following elements appear on the display:

- **V Gain:** Shows the current vertical gain setting when the gain is other than 1x. Press the GAIN button to toggle the vertical gain between 1x and the most recently selected vertical gain value. Press and hold the GAIN button to select fixed gain settings (1x, 2x, 5x, or 10x) or to enable VAR Gain mode. If you enable VAR Gain mode in the Gain pop-up menu or by pressing the VAR button, you can adjust the vertical gain using the General knob.

- **H Gain:** Shows the current horizontal gain setting when the gain is other than 1x. Press the MAG button to toggle the horizontal gain between 1x and the most recently selected horizontal gain value. Press and hold the MAG button to select fixed gain settings (2x, 5x, or 10x) or to enable VAR H Gain mode. If you enable Variable H Gain mode, you can adjust the horizontal gain using the General knob.

- **Display Type:** The selected display, either Lightning or Vector.

- **Bar Target Setting:** The bar target setting, either 75% or 100%.

- **H** and **V** positions: When you press the POS button to adjust the position of the waveform, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

- **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Vector pop-up menu (Lightning display)

Press and hold the VECTOR button to open the Vector pop-up menu. The pop-up menu enables you to specify the display type and display mode, to set the bar targets, and to center the waveform in the display. The following menu selections are available:

Display Type.   Select from the following display types:

- **Vector** – The Vector display shows a plot of the Pr signal on the vertical axis and the Pb signal on the horizontal axis. This display is useful for looking at hue and amplitude of the colors, but does not show luminance information. (See page 110, *Vector display*.)

- **Lightning** – This Tektronix proprietary display shows the same Pr and Pb color signals as in the Vector mode, but they are plotted against luminance.

Bar Targets.   To select which scaling (75% or 100%) will be used in the current tile for either the Vector or Lighting display.

Center Waveform.   Select this option to cancel any horizontal or vertical position adjustments and restore the trace to the default position at the center of the tile.

CONFIG menu

Use the CONFIG menu to set the following Lightning display parameters:

- Set the **SDI Input > HD Colorimetry** setting to **Auto**, **ITU 709-2**, or **SMPTE 240M** to set the expected colorimetry in HD signals.

- Set the **Graticules & Readouts > Vector Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

To position the Lightning trace

To adjust the position of the trace on the Lightning display:

1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout.

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

LTC Waveform display

The LTC (Longitudinal Time Code) Waveform display is a frame rate display of the signal on the LTC IN connector to allow observation of amplitude, synchronization, and phase. The displayed waveform is basically a 2-field sweep and corresponds to a video frame. The LTC phase should remaining consistent relative to the frames that it is supposed to count.

To access the LTC Waveform display

1. Press and hold the **WFM** button to open the Waveform pop-up menu.

2. Use the arrow keys to select **Display Type > LTC Waveform**.

3. Press the **WFM** button to close the pop-up menu.

Elements of the LTC Waveform display
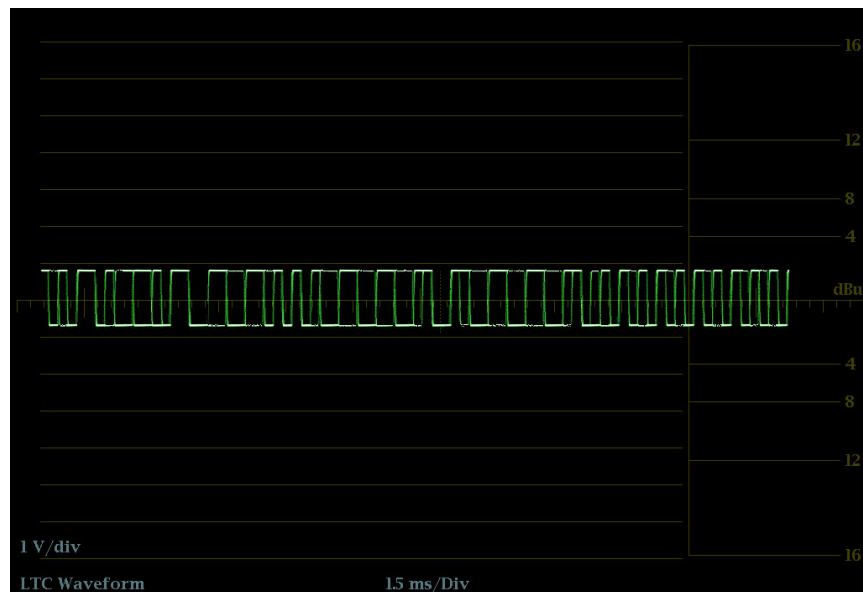

Figure 25: LTC Waveform display

- ■ **Display**: Shows the display type as LTC Waveform.

- ■ **Y-axis units**: Shows the y-axis units in volts/divisions.

- ■ **X-axis units**: Shows the x-axis in milliseconds/divisions.

- ■ **V Gain**: When you press the GAIN or VAR buttons to change the gain setting, a V Gain readout appears.

- ■ **H** and **V** positions: When you press the POS button to adjust the position of the waveform, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

Waveform pop-up menu
(LTC Waveform display)

Press and hold the WFM button to open the Waveform pop-up menu. The pop-up menu enables you to configure the display type and to center the waveform. The following menu selections are available:

Display type. Select from the following display types:

■ **Waveform** - Displays a voltage versus time plot of the selected SDI input signal (SDI A or SDI B). (See page 114, *Waveform display*.)

■ **LTC Waveform** - Displays a voltage versus time plot of the LTC input signal (LTC IN).

■ **Ref Waveform** - Displays a voltage versus time plot of the external reference input signal (REF IN). (See page 67, *External Reference Waveform display*.)

Center waveform. Select this option to cancel any horizontal or vertical position adjustments and restore the trace to the default position.

CONFIG menu

Use the CONFIG menu to set the following LTC Waveform display parameters:

■ Set the **Graticules & Readouts > Waveform Readouts** setting to **On** or **Off** to turn on or off the readouts on the Waveform display.

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity, graticule color, and enabling the thumbnail view.

■ Set the **Alarms > Timecode** settings as desired to enable timecode alarms.

■ Set the **Aux Data Setting > Timecode Source** selection as appropriate for the type of timecode signal you are using.

To position the
LTC Waveform trace

To adjust the position of the trace on the LTC Waveform display:

1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout.

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

Picture display

The Picture display shows the picture generated by the selected video signal. You can choose to display the picture with or without a picture frame, VChip ratings, closed captioning (CC), teletext, and safe area graticules.

For more information, see *Closed captioning (CC), teletext, AFD, and safe area compliance*. (See page 176.)

To access the Picture display

Press the PICT button to display a picture of the selected video input signal.

Elements of the Picture display

No CC/Teletext

0661-009
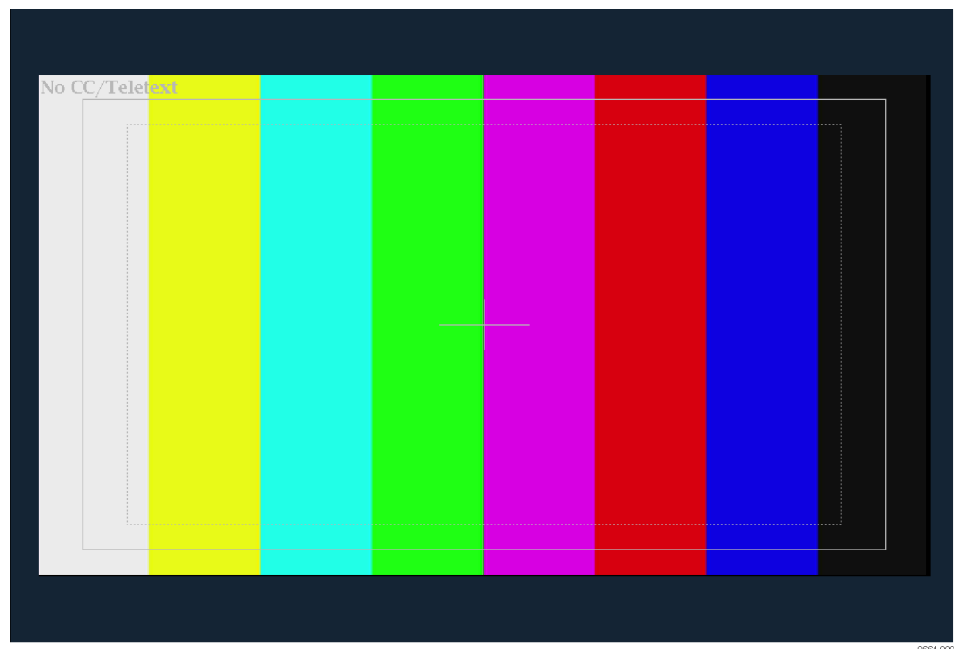
Figure 26: Picture display of color bars signal with Safe Area and Picture Center graticules enabled

- **Picture** – In full-screen mode, there is no cropping. Pictures are decimated horizontally and vertically to obtain the correct aspect ratio. This decimation may introduce minor artifacts in some images and may be more evident on a sweep signal.

  In Quad Tile display mode, the picture is decimated to fit in the space available. For example, for 525-line signals, 12 lines are cropped (6 at the top and 6 at the bottom) to make the image fit.

- **VChip rating:** Displays detected VChip ratings from any of these systems: MPAA (US), TV (US), Canadian English, and Canadian French. VChip information is labeled CA (Content Advisory).

■ **Safe Action area and Safe Title area graticules** – When enabled, Safe Action and Safe Title area graticules are displayed to show the safe areas of the picture to aid in monitoring for incorrect placement of graphics, logos, and other branding elements to ensure that they do not obscure text of essential action. The graticule areas indicate the maximum image area within which all significant action or titles should be contained.

The graticule sizes are defined by the selected standard (SMPTE, BBC, or ARIB B-4) and the selected aspect ratio (Auto, 4x3, 14x9, 16x9, or Custom). Custom settings will override the aspect ratio of the monitored input. You can display up to four safe area graticules (two Safe Action and two Safe Title) at a time. You can specify up to two custom safe area graticules.

■ **Picture Center graticule** – When enabled, shows the center of the picture image.

■ **AFD graticules** – When enabled, AFD (Active Format Descriptor) graticules are displayed if AFD is included in the signal. When AFD is not included in the signal, the message "AFD: Not Detected" is displayed.

■ **Line Select cursor** – When the Picture Line Select Cursor is enabled in the CONFIG > Graticules & Readouts menu, the cursor highlights the selected line in the picture when Line Select mode is enabled.

■ **Closed Caption Text and Teletext content:** Displays closed captioning or Teletext, configurable to decode to the following Closed Caption and Teletext standards. When no content is detected, the message "No CC/Teletext" is displayed.

　－ For SD: CEA-608-line-21, TeletextB VBI (625), CEA-608 (ANC), CEA-608 (708), CEA-708, TeletextB VBI, TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)

　－ For HD and 3G: CEA-608 (ANC), CEA-608 (708), CEA-708, TeletextB VBI, TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)

■ **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Picture pop-up menu　Press and hold the PICT button to open the Picture pop-up menu. The pop-up menu enables you to display Safe Area, AFD, and Picture Center graticules and to display Closed Caption and Teletext content.

■ **Picture Frame**: Turns the Picture Frame display On or Off. When turned on, only the active video portion of the signal is displayed. When turned off, the elements of the signal that are outside of the active video signal such as user data, embedded audio, and the vertical interval are visible.

■ **CC/Teletext Format**: Select the format of the closed caption content in the video signal. You can select from Off, Auto, CEA608, CEA708, and WST.

- **CEA608 CC Services**: If you are monitoring CEA 608 content, select the channel that you want to monitor. You can select from CC Channel 1 through 4 and Txt Channel 1 through 4.

- **CEA708 CC Services**: If you are monitoring CEA 708 content, select the service that you want to monitor. You can select from Service 1 through 6.

- **TtxtB Page**: If you are monitoring Teletext B content, select the page number that you want to monitor.

- **Safe Area Action 1/2, Safe Area Title 1/2**: Set the aspect ratio of the selected Safe Area Action or Safe Area Title graticule. Select from Off, Auto, 4x3, 14x9, 16x9, Custom_1, and Custom_2. Use the Custom Safe Action/Title settings in the CONFIG > Graticules & Readouts menu to define the custom safe areas.

- **AFD Graticules**: If AFD is included in the signal, use this setting to turn AFD graticules on or off.

- **Picture Center Grat**: Turns the graticule showing the center of the picture on or off.

CONFIG menu   Use the CONFG menu to set the following Picture display parameters:

- Use the **Graticlues & Readouts > Safe Area Graticule Standard** selections to select the standard used for Safe Action and Safe Title area graticules.

- Use the **Graticlues & Readouts > Custom Safe Action/Title** selections to set the dimensions and offset for the custom Safe Action and Safe Title area graticules.

- Use the **Graticlues & Readouts > Picture Line Select Cursor** setting to turn on or off the highlight of the selected line in the picture when Line Select mode is enabled.

- Use the **Graticules & Readouts > Picture Readouts** setting to turn on or off the readouts and graticules on the Picture display.

- Set the **Aux Data Settings > CEA 608 Settings** selections as appropriate if you are monitoring video with CEA 608 closed caption content.

- Set the **Aux Data Settings > CEA 708 Settings** selections as appropriate if you are monitoring video with CEA 708 closed caption content.

- Set the **Aux Data Settings > Teletext B Settings** selections as appropriate if you are monitoring video with Teletext B content.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity, graticule color, and enabling the thumbnail view of the Picture display in the Waveform, Vector, or Gamut displays. (See page 32, *DISPLAY SELECT button*.)

Split Diamond display

Like the Diamond display, the Split Diamond display is a Tektronix proprietary display that shows gamut violations of the SDI input if translated to the RGB color space. For more information about using the gamut-checking displays:

- See *Arrowhead display* (See page 48.)

- See *Diamond display* (See page 65.)

- See *Checking gamut* (See page 145.)

- See the *Preventing Illegal Colors* application note available on the Tektronix Web site (www.tektronix.com)

To access the Split Diamond display

1. Press and hold the **GAMUT** button to open the Gamut pop-up menu.

2. Use the arrow keys to select **Display Type > Split Diamond**.

3. Press the **GAMUT** button to close the pop-up menu.

Elements of the Split Diamond display
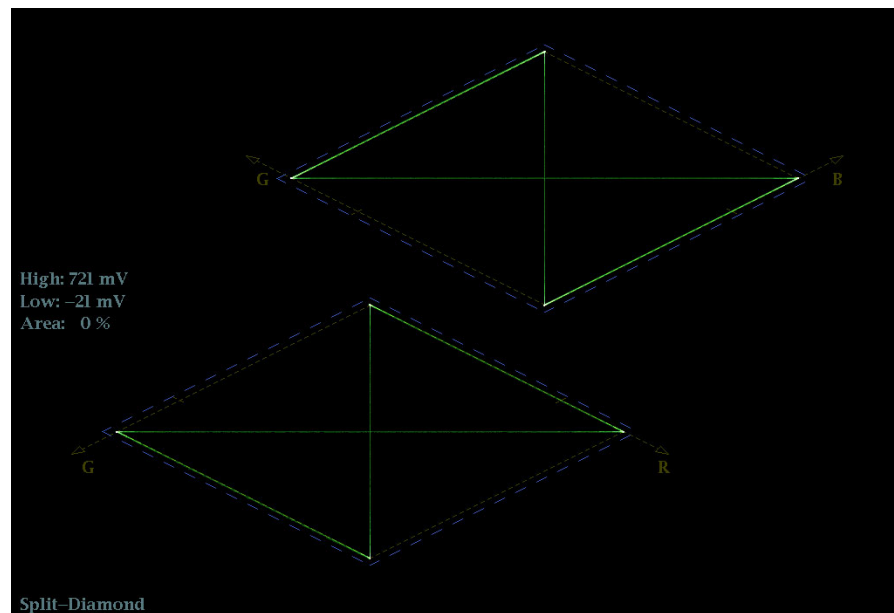
Figure 27: Split Diamond display

- **High threshold:** Shows the currently specified Diamond High threshold setting in the CONFIG > Gamut Thresholds menu.

- **Low threshold:** Shows the currently specified Diamond Low threshold setting in the CONFIG > Gamut Thresholds menu.

- **Gamut display type:** Shows the selected Gamut display type - Arrowhead, Diamond, or Split Diamond.

- **Threshold indicators:** Indicates the threshold settings using blue dashed lines.

- **Y Area:** Shows the specified percentage of the total image pixels that can be outside the current gamut limits and not generate error reports.

- **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

Gamut pop-up menu (Split Diamond display)

Press and hold the GAMUT button to open the Gamut pop-up menu. The pop-up menu enables you to select the from the following Tektronix proprietary gamut displays:

- **Arrowhead** - Displays gamut violations of the SDI input if translated into the Composite domain (NTSC and PAL). (See page 48, *Arrowhead display*.)

- **Diamond** - Displays gamut violations of the SDI input if translated to RGB color space. (See page 65, *Diamond display*.)

- **Split Diamond** - Like the Diamond display, displays gamut violations of the SDI input if translated to the RGB color space. However, the Split Diamond display offsets the two halves of the Diamond display to allow you to better see negative RGB gamut errors.

CONFIG menu

Use the CONFIG menu to set the following Split Diamond display parameters:

- Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports, and reset the gamut and luma limits to default values.

- Use the menu selections under **Alarms > Video Content** to enable the alarms for the Split Diamond display.

- Set the **Graticules & Readouts > Gamut Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

Status displays

The Status display provides several text views that show the status of the signal. You can view current alarms and errors (those occurring now and within the last few seconds), a history of errors and alarms (up to 10,000 entries), video error statistics or audio error statistics. You can display a different Status display type in all four tiles.

To select a status display

1. Press and hold the **STATUS** button to open the Status pop-up menu.

2. Use the arrow keys to select one of the following displays:

   - **Display Type > AES Channel Status** – Displays the status of the specified audio channels in the specified format. (See page 85.)

   - **Display Type > Alarm Status** – Displays the current status of alarms. (See page 87.)

   - **ARIB Display >** *display mode* – Displays the selected ARIB status display. (See page 88.)

   - **Display Type > Audio Control** – Displays the metadata encoded in the audio control packet. (See page 89.)

   - **Display Type > Audio Session** – Displays several performance parameters which provide an overview of the audio input signal. (See page 92.)

   - **Display Type > Auxiliary Data Status** – Displays the status of the auxiliary data in the video signal such as closed caption, teletext, AFD, and V-chip rating. (See page 95.)

   - **Display Type > Dolby Status** – Displays the Dolby metadata from the VANC in the currently monitored SDI input. (See page 97.)

   - **Display Type > Error Log** – Displays a log of the error events that have been detected since the instrument was turned on or since the log was last reset. You can view all of the errors or just the errors for the selected input and save the log to a USB memory device. (See page 99.)

   - **Display Type > Video Session** – Displays several performance parameters which provide an overview of the video input signal. (See page 102.)

3. Press the **STATUS** button to close the pop-up menu.

AES Channel Status display

The AES Channel Status display presents the AES channel status packet content from the select channel pair. The data can be presented in binary, XMSN (transmission order) binary, hexadecimal, or text (interpreted) format.

AES Channel Status		
Format: Text	Audio Input:	Embedded A
Field Name	Ch L(1)	Ch R(2)
Channel use	professional	professional
Linear PCM Ident	PCM	PCM
Emphasis	no emphasis	no emphasis
Locking of source	locked	locked
Sample frequency	48 kHz	48 kHz
Channel mode	2–channel	2–channel
User bits mode	192–bit blocks	192–bit blocks
AUX bits use	main audio	main audio
Audio word length	24/24 bits	24/24 bits
Alignment level	not indicated	not indicated
Reference signal	not a ref.	not a ref.
Origin	A1–1	A1–2
Destination		
Sample number	0	0
Time of day	00:00:00	00:00:00
Block CRC (should be)	01001100	01100110
Block CRC (computed)	01001100 (OK)	01100110 (OK)

0661-015

Figure 28: AES Channel Status display

Elements of the Channel Status display.

■ **Format:** Shows the format of the data in the display.

■ **Audio Input:** Shows the selected audio input.

■ **Field Name:** Lists the field names of the various data in the AES channel status packet.

■ **Ch *number* columns:** Lists the content for the various data in the AES channel status packet for each of the selected channels.

Status pop-up menu (AES Channel Status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

- **Display Type** and **ARIB Display:** Use the arrow keys to select the display type. (See page 84, *To select a status display*.)

- **Channels:** Use the arrow keys to select the channel pair to display:

  - Channels 1 & 2 (L and R)

  - Channels 3 & 4 (C and LFE)

  - Channels 5 & 6 (Ls and Rs)

  - Channels 7 & 8 (Lo and Ro)

- **Format:** Use the arrow keys to select the format of the data display. Select from Text, Hex, Binary, or XMSN Binary formats.

CONFIG menu. Use the CONFIG menu to set the following audio parameters:

- Use the menu selections under **Digital Audio Displays** to configure various audio display parameters such as meter type, ballistic characteristics, peak program level, meter scaling, alarm thresholds, correlation speed, and turning the Lissajous AGC mode on and off.

- Use the menu selections under **Audio Inputs/Outputs** to configure audio input and output parameters such as selecting which channels are active on each audio input port, selecting how each audio port is displayed, selecting the audio output source, selecting which channels to de-embed from the SDI video, configuring the "map" of active audio for each video input, and adjusting the speaker and headphone volume.

  If Option 3G is installed, 3G Level A signals use the Embedded A or B settings as appropriate. 3G Level B signals use the Embedded Dual Link settings.

- Use the menu selections under **Alarms > Audio Content** and **Alarms > AES/Embedded** to enable various audio alarms.

Alarm Status display

The Alarm Status display shows the current status of all triggered alarms for the currently selected video and audio inputs, and indicates whether or not they have been enabled. Use the arrow keys to navigate through the different pages of the display.

Alarm Status		Page 2 of 4
Alarm	Status	Additional Information
Embed Aud Missing	Error	7890123456789012
Embed Aud Chksum	OK	
Embed Aud Parity	OK	
Audio Cntl Pkt Missing	OK	
Audio CRC Error	OK	
Audio Valid Bit	OK	
Audio Parity Error	OK	
Audio Clip	OK	
Audio Over Level	OK	
Audio Mute	OK	
Audio Silence	OK	
Audio Channel Loud	OK	
Audio Program Loud	OK	
Audio Session Loud	OK	
Audio Program Quiet	OK	
Audio Session Quiet	Error	12------
Dialnorm mismatch	OK	
Timecode Vitc Missing	Error	
Timecode Vitc Invalid	OK	
Timecode Ltc Missing	Error	
Timecode Ltc Invalid	OK	
Timecode Anc VITC Missing	OK	
Timecode Anc VITC Invalid	Error	VITC Field Invalid, Dropframe mismatch
Timecode Anc LTC Missing	OK	
Timecode Anc LTC Invalid	Error	Dropframe mismatch,
Arrow Left, Up – Previous page, Right, Down – Next page.		

Figure 29: Alarm Status display

Elements of the Alarm Status display.

- **Alarm:** Lists the alarms that have been triggered (**white** text indicates the alarm is being logged, **gray** text indicates that the alarm is not being logged).

- **Status:** Shows the status of the error:

  - **OK** – Indicates that the alarm is not being triggered or has not occurred in the five seconds.

  - **Error** – Indicates that the alarm is occurring or has occurred in the last five seconds.

  - **Green text** – Indicates that an error occurred but has cleared.

  - **Yellow text** – Indicates that an error occurred in the last five seconds but has cleared.

- **Red text** – Indicates that an error is currently active.

- **Gray text** – Indicates that an alarm has been generated but the alarm was not enabled for logging.

■ **Additional Information:** Provides explanatory information about the error, if available. For example, if an Audio Signal Loss alarm is triggered, the text 123–678 may appear. These numbers indicate that the audio channels mapped to level meter bars 1,2,3,6,7, and 8 triggered the alarm.

Status pop-up menu (Alarm Status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

■ **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

■ **Mute Alarms:** Mutes alarms for all of the Status display types. An Alarms Muted icon appears in the Status Bar. (See page 37, *Status bar icons*.)

CONFIG menu. Use the CONFIG menu to set various parameters that will generate error reports in the Error Log status display. Some of those parameters are listed below.

■ Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, and specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports.

■ Use the menu selections under **Alarms** to enable various alarms that will be reported in the log.

■ Use the menu selections under **Aux Data Settings** to set various expected data parameters.

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

ARIB status displays   Use the ARIB status displays to check for the presence and status of ARIB-based information encoding. The instrument supports TR-B.22, TR-B.23-1, TR-B.23-2, B.35, B.37, and B.39 ARIB standards.

To view the ARIB content displays, you must first enable them using the **CONFIG > Aux Data Settings > ARIB Content Display** setting.

For detailed information about ARIB displays, go to the *ARIB status displays* section in this manual. (See page 151.)

Audio Control Packet status display

The Audio Control Packet status display allows you to view information on audio frame number, sampling frequency, active channels, and relative audio-to-video delay of each channel, as encoded in the audio control packet metadata. (See Figure 30.)
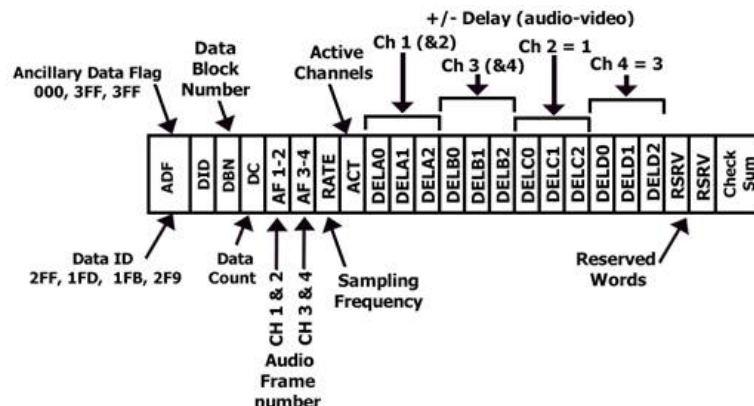
Figure 30: Format of the Audio Control Packet

For SD signals, transmission of audio control packets is optional for 48 kHz synchronous operation and required for all other modes of operation (since it contains the information as to what mode is being used). Where frequent switching is planned, receiving equipment can be designed to add or drop a sample following a switch in the four out of five cases where the sequence is broken.

The challenge in such a system is to detect that a switch has occurred. This can be facilitated by use of the data block number in the ancillary data format structure and by including an optional frame counter with the unused bits in the audio frame number word of the audio control packet. (See Figure 31.)
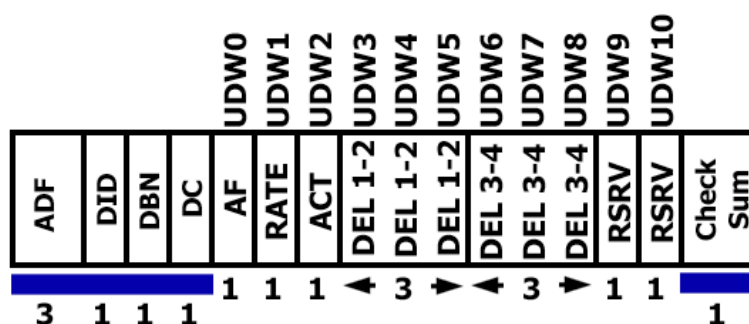
Figure 31: Structure of the Audio Control Packet

For HD signals, the audio control packet carries additional information used in the process of decoding the audio data and has a similar structure to standard definition.

Figure 32: Audio Control Packet status display

Elements of the Audio Control Packet status display. The elements of the Audio Packet display vary depending on the monitored signal.

■ **Group 1 through _n_**: Shows the audio group number of the audio control packet to be used for decoding.

■ **DID**: Shows the Data Identifier of the ancillary data packet for the audio control packet. For specific information about permissible DID values, view the help file in your instrument: while the Audio Control display is active in a tile, press the HELP button and follow the link at the bottom of the page to _Audio Control Packet Display Elements_.

■ **Data Block**: Always 200h for HD. If SD is present, this increments by 1 when consecutive data for each DID is present, or when data blocks within a common data ID are to be linked.

■ **Data Count**: 10Bh for HD. For SD, the data count represents the number of user data words to follow, up to a maximum of 255 words.

■ **Field/Line**: Shows the field of the audio from which the packet was acquired. The line of the audio (within the field) from which the packet was acquired.

■ **Checksum**: Shows the checksum word that was recovered from the acquired packet.

- ■ **Should be**: Shows the checksum word computed by the instrument, based on the packet data.

- ■ **Channel**: Shows the specific channel(s) to which the Audio Frame, Rate (kHz), Active Chan, and Delay Samples data apply. The AES stream allows up to 16 channels of audio data, and every 4 channels are transmitted together as an audio group.

- ■ **Audio Frame**: Audio frame (AF) number data provide a sequential numbering of video frames that indicate where they fall in the progression of the non-integer number of samples per video frame (audio frame sequence). The first number of the sequence is always 1 and the final number is equal to the length of the audio frame sequence. An audio frame value of one or more zeroes indicates that frame numbering is not available.

- ■ **Rate (kHz)**: Shows the audio sampling rate.

- ■ **Active Chan**: Shows whether the audio channel is active or inactive.

- ■ **Delay Samples**: Shows the amount of accumulated audio processing delay relative to video, measured in audio sample intervals.

Status pop-up menu (Audio Control status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

- ■ **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

- ■ **Mute Alarms:** Mutes alarms for all of the Status display types. An Alarms Muted icon appears in the Status Bar. (See page 37, *Status bar icons*.)

CONFIG menu. Use the CONFIG menu to set the following audio parameters:

- ■ Use the menu selections under **Digital Audio Displays** to configure various audio display parameters such as meter type, ballistic characteristics, peak program level, meter scaling, alarm thresholds, correlation speed, and turning the Lissajous AGC mode on and off.

- ■ Use the menu selections under **Audio Inputs/Outputs** to configure audio input and output parameters such as selecting which channels are active on each audio input port, selecting how each audio port is displayed, selecting the audio output source, selecting which channels to de-embed from the SDI video, configuring the "map" of active audio for each video input, and adjusting the speaker and headphone volume.

  If Option 3G is installed, 3G Level A signals use the Embedded A or B settings as appropriate. 3G Level B signals use the Embedded Dual Link settings.

- ■ Use the menu selections under **Alarms > Audio Content** and **Alarms > AES/Embedded** to enable various audio alarms.

Audio Session status display

The Audio Session status display contains several performance parameters that you can display to see an overview of the audio input signal. This instrument maintains a running audio status session. (See Figure 33.)

Figure 33: Audio Session status display

Elements of the Audio Session status display.

- **Audio Input**: Shows the selected input source.

- **Signal Loss**: Indicates the level meter bars (1-8) that have triggered a signal loss alarm. Dashes indicate that no alarm was triggered.

- **AES Output**: Shows the

- **Data Collect**: Indicates the status of error collection as Running or Stopped.

- **Channel**: This row aligns the channel number with the status readouts that appear below the row.

- **Clip**: The number of CLIPs detected during the session. (Only displayed for digital audio feeds.)

- **Over**: The number of OVERs detected during the session. (Only displayed for digital audio feeds.)

- **Mute**: The number of MUTEs detected during the session.

- **Silence**: The number of SILENCEs detected during the session.

- **Peak (dBFS)**: The True Peak signal level measured on the channel.

- **High (dBFS)**: The highest signal level measured by the signal level meter. The level meter response is based on the Ballistics setting. If ballistics is set to True Peak, this readout is the same as the Peak readout.

- **Active Bits**: The number of active bits in the channel. For SD Embedded Audio the maximum is 20 bits.

- **Smpl Rate**: The sample rate of the channel pair.

- **Changed Since Last Reset**: Either Yes or No. Indicates whether an error has occurred since the last reset.

Status pop-up menu (Audio Session display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

NOTE. To reset, stop, or start an individual audio or video session, select the tile in which it is displayed and use the SEL button, right arrow key, and left arrow key, respectively. Remember that the STATUS pop-up menu must be closed. Otherwise, the button and key presses will navigate through that menu.

- **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

- **Mute Alarms**: Mutes alarms for all Status display types.

- **All Sessions Reset**: Globally resets any and all audio sessions displayed in all panes, regardless of the display and session from which it is executed.

- **All Sessions Start**: Globally starts any and all stopped audio sessions displayed in all panes, regardless of the display and session from which it is executed.

- **All Sessions Stop**: Globally stops any and all stopped audio sessions displayed in all panes, regardless of the display and session from which it is executed.

CONFIG menu. Use the CONFIG menu to set the following audio parameters:

■ Use the menu selections under **Digital Audio Displays** to configure various audio display parameters such as meter type, ballistic characteristics, peak program level, meter scaling, alarm thresholds, correlation speed, and turning the Lissajous AGC mode on and off.

■ Use the menu selections under **Audio Inputs/Outputs** to configure audio input and output parameters such as selecting which channels are active on each audio input port, selecting how each audio port is displayed, selecting the audio output source, selecting which channels to de-embed from the SDI video, configuring the "map" of active audio for each video input, and adjusting the speaker and headphone volume.

If Option 3G is installed, 3G Level A signals use the Embedded A or B settings as appropriate. 3G Level B signals use the Embedded Dual Link settings.

■ Use the menu selections under **Alarms > Audio Content** and **Alarms > AES/Embedded** to enable various audio alarms.

Auxiliary Data Status display

The Auxiliary Data Status display allows you to view closed-caption, teletext, video index, AFD, WSS, V-chip related status, and other ancillary data present on monitored signals.
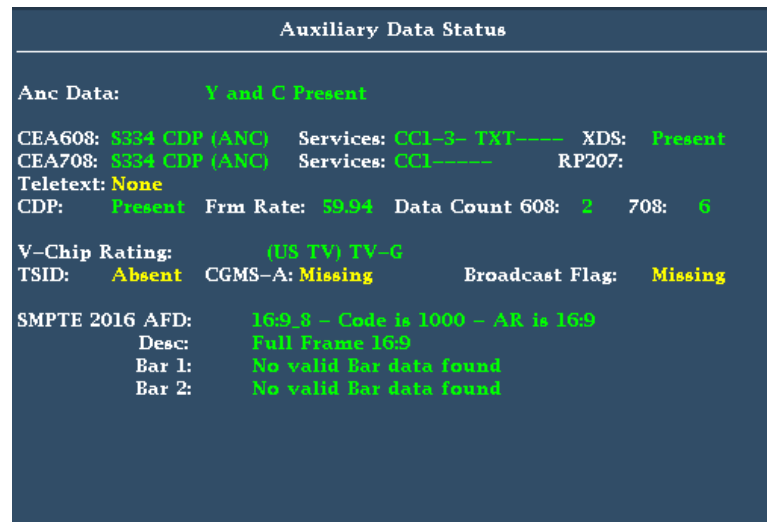
Figure 34: Auxiliary Data Status display

Elements of the Auxiliary Data Status display.

- **Ancillary Data Present**: Indicates if ANC data is present in the SDI stream.

- **CC/Teletext Type**: Indicates the Closed Caption or Teletext type in use, with the element turning red if an error is detected or the type is missing. Possible values are CEA-608 (VBI), CEA-608 (ANC), CEA-608 (708), CEA-708, Teletext B (WST) / VBI, Teletext B (WST) / OP47 SDP, Teletext B (WST) / OP47 Multi. If the CC type data is present, but is either late or early, the error message is displayed in yellow.

- **CEA 608**: Indicates the number and type of services present in the closed caption data CEA608 format. If a service has no activity for 30 seconds, it is considered missing.

- **CEA 708**: Indicates the number and type of services present on closed caption data in CEA708 format. If a service has no activity for 30 seconds, it is considered missing.

- **RP207**: Indicates the presence of Program Description Data.

- **Teletext**: Detects the location and line numbers for which teletext information is present.

- **CDP**: Indicates the presence of Caption Distribution Packets and provides information on frame rate and data count of 608 and 708 packets. Note that packet 608 typically has 4 data words and packet 708 has up to 46 data words, depending on the frame rate as defined in SMPTE 334.

- **V-Chip Rating**: Detects ratings from: MPAA (US), TV (US), Canadian English, and Canadian French systems.

- **Transmission Signal Identifier (TSID)**: Indicates if the TSID is present in the SDI stream. If missing, "Not Detected" will display; otherwise, the TSID is displayed as a hexadecimal number.

- **Copy Generation Management System-Analog (CGMS-A)**: Indicates if the CGMS-A is present in the signal. If missing, "Not Detected" will display; otherwise, the CGMS-A value is displayed.

- **Broadcast Flag**: Indicates if a broadcast flag was detected or not.

- **Timecode (TC) Flags**: Indicates the timecode status. The drop frame (DF) is 0 when drop frame compensation is being performed normally. DF is 1 when the count is not drop frame compensated. The color frame (CF) status is 0 when there is no relationship between the CF sequence and the time address. CF is 1 when CF ID is applied to the time address.

- **Pol**: Indicates the biphase polarity correction.

- **BG Flags**: Indicates the binary group (BG) values and whether they are specified. The readout will display a number from 0 to 7. For example, bit 0 is BGF0, bit 1 is BGF1, and bit 2 is BGF2.

- **BG Data**: Indicates the binary group (BG) data value.

- **Wide Screen Signaling (WSS)**: Indicates if the WSS is present. The supported formats include Composite PAL and 625-line SD. The WSS data is displayed with the hexadecimal byte value and its description. WSS decoding conforms to standard ITU-BT.1119-2.

- **Active Format Description (AFD)**: Indicates if the SMPTE 2016-1 and 3 Format for Active Format Description and Bar Data is present. The AFD data is displayed with the hexadecimal byte value and its description. AFD decoding conforms to standard SMPTE 2016 1-3.

- **Video Index Scanning B2-B0**: Shows the Video Index Scanning System information. Conforms to SMPTE RP186-2008 Class 1.1. Data Octet 1. Scanning System provides information about the total number of lines, field rate, and aspect ratio.

- **Video Index AFD/ARD B6-B3**: Shows the Video Index binary value of Bits 6 to Bits 3 that are used to define the Active Format Descriptor. Conforms to SMPTE RP186-2008 Class 1.1. or ARDSPEC 1. See the instrument online help for a detailed description of codes: while the Aux Data Status display is active in a tile, press the HELP button.

Status pop-up menu (Auxiliary Data Status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

- **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

- **Mute Alarms**: Mutes alarms for all Status display types.

- **Reset ANC Data**: Resets any and all Auxiliary Data Status sessions displayed in all panes, regardless of the display and session from which it is executed.

CONFIG menu. Use the CONFIG menu to set the following Auxiliary Data Status display parameters:

- Use the **Aux Data Settings** selections to define the ANC data types by name and DID/SDID values.

- Use the menu selections under **Alarms** to enable the alarms for various types of ANC data errors.

Dolby Status display   You can view Dolby metadata from the currently monitored SDI input. Select to view the metadata from the VANC.

Figure 35: Dolby Status display

Elements of the Dolby Status display. The following is a list of some of the elements that show on the Dolby Status display. Some elements apply only to Dolby type E. If Dolby type D is detected, these elements display with their names grayed out and with a value of N/A. For a complete list of the elements that might appear, see the instrument online help by pressing the **HELP** button when the Dolby Status display is active in a tile.

■ **Program Description Text**: A 32-character ASCII text field used by the program author to describe the audio program; for example, the name of the program (Movie Channel Promo), the program source (Football Main Feed), or the program language (Danish).

■ **Dolby Format**: Indicates the Dolby Format. This indicator is also tied to the Dolby Format Error/Alarm: if the Alarm is asserted, the Dolby Format is displayed in red.

■ **Channel Mode (or Audio Coding mode)**: Indicates the active channels within the encoded bit stream, representing it in a ratio, X/Y, where X is the number of front channels (Left, Center, Right) and Y is the number of rear (Surround) channels. If the LFE Channel is present, an L is appended at the end of the channel mode.

■ **Program Configuration**: Determines how the audio channels are grouped within a Dolby E bitstream. Up to eight channels can be grouped together in individual programs, where each program contains its own metadata.

■ **Dolby Source**: Indicates the instrument input from which the Dolby Content is sourced.

■ **Dolby Data Rate**: For Dolby D, indicates the encoded data rate; for Dolby E, indicates the data rate that would be used to encode a Dolby Digital bitstream.

■ **Dolby Sample Rate**: Indicates the sample rate of the decoded Dolby Digital bitstream.

■ **Bitstream Mode**: Describes the audio service contained within the Dolby Digital bitstream. A complete audio program may consist of a main audio service (a complete mix of all the program audio), an associated audio service comprising a complete mix, or a main service combined with an associated service. For more information about possible values, see the instrument online help; when the Dolby Status display is active in a tile, press the HELP button.

■ **Dolby E Frame Rate**: Indicates the Dolby E frame rate. If Dolby Frame Rate is not the same as the video Frame Rate, the rate value is displayed in red.

■ **Dolby E Frame Loc**: Displays the location (line number and sample number) of the SMPTE337 pre-amble. Also displays the Dolby E sync words one and two for bit depths of 16, 20, and 24.

■ **Dolby PA Alignment**: Indicates an alignment error between the left and right Dolby channels.

■ **Dialog Level**: Represents the long-term, A-weighted average level of dialog within a presentation, LAeq.

Status pop-up menu (Dolby Status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

■ **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

■ **Mute Alarms**: Mutes alarms for all Status display types.

■ **VANC Ch Pair DID**: Sets the VANC Dolby metadata source to 45h (Std) or 50h.

■ **VANC Ch Pair SDID**: Sets which channel pair in the embedded audio is associated with the VANC Dolby metadata.

■ **Dolby E Program**: Selects the Dolby E program number to be displayed (1 through 8).

Error Log status display

The Error Log status display shows a log of the error events that have been detected since the instrument was turned on or since the log was last reset. You can view all of the errors or just the errors for the selected input and save the log to a USB memory device.

Active Log		Filter: All 11/12/2010		Page 4 of 4
	Source	Error Status	Timecode	Time
⅃		Audio Mute		14:37:27
⌐	SDI 1A	RGB Gamut Error (–r——b)		14:37:28
⌐	SDI 1A	Composite Gamut Error (C–)		14:37:28
∧	SDI 1A	C Anc Parity Error (Error)		14:37:28
∧		Audio CRC Error (123456——————)		14:37:28
∧	SDI 1A	C Anc Parity Error (Error)		14:37:28
∧	SDI 1A	Field Length Error (Strm 1&2 Error)		14:37:28
⌐	SDI 1A	C Anc Parity Error (Error)		14:37:28
∧	SDI 1A	Embed And Parity (1234567890123456)		14:37:28
⌐	SDI 1A	RGB Gamut Error (Rr—Bb)		14:37:28
⅃	SDI 1A	Luma Gamut Error		14:37:28
⅃	SDI 1A	RGB Gamut Error		14:37:29
∧		Audio Mute (1234——————————)		14:37:29
⅃	SDI 1A	Y Anc Parity Error (OK)		14:37:29
⅃	SDI 1A	C Anc Parity Error (OK)		14:37:29
⅃		Audio Signal Loss		14:37:30
⌐	SDI 1A	Audio Session Loud (1————————)		14:38:37
⌐	SDI 1A	Audio Session Loud (1————————)		14:38:37

Arrow Left – Previous, Right – Next, Up – First, Down – Last.

Figure 36: Error Log status display

Elements of the Error Log status display. Across the top of the display screen, the following items are shown:

■ **Log status**: Shows that the currently viewed log is active (**Active Log**) or that logging has stopped (**Active Log (Stopped)**).

■ **Filter**: Shows the currently selected error filter. *All* means that all errors from all inputs and channels are being shown. You can also select to view errors by input or channel.

■ **Date**: Shows the date, according to the internal clock of the instrument, that the error occurred. The date is displayed as month/day/year.

■ **Page**: Shows which page of the log you are viewing out of the total number of pages in the log.

The Error Log display is divided into the following columns:

■ **Entry type (icon)**: An icon is displayed next to each log entry to provide a quick indication of the entry type:

   – **"i"**: Identifies log entries that are informational in nature. These entries do not represent an error, but usually indicate changes in instrument state, such as a change in the video input source.

   – **Red Rising Waveform**: Indicates that an error has occurred.

   – **Green Falling Waveform**: Indicates that an error has cleared.

■ **Source**: Shows the inputs on which the errors have occurred.

■ **Error Status:** Shows the current state of the entry: **White** items are informational and identify a change in instrument state; **Green** items are errors that have cleared; **Red** items are triggered errors.

■ **Timecode:** Shows the time, according to VITC or LTC in the signal, that the error occurred. In the case of ongoing errors, this shows the VITC/LTC at which the error first occurred.

■ **Time:** Shows the time, according to the internal clock of the instrument, that the error occurred.

Status pop-up menu (Error Log status display). Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

- **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

- **Mute Alarms:** Mutes alarms for all of the Status display types. An Alarms Muted icon appears in the Status Bar. (See page 37, *Status bar icons*.)

- **Logging Active:** Turns the logging function on or off. The logging status is shown at the top of the display. When turned on, "Active Log" is displayed. When turned off, Active Log (Stopped) is displayed.

- **Logging Reset:** Press the **SEL** button to clear all of the entries in the log. Use care when executing a reset because the log entries cannot be recovered after a reset has erased them.

- **Input/Channel:** Allows you to select to filter errors in the error log so that you can view them by channel or input.

- **Save to USB (ALL):** Saves the entire unfiltered error log to a USB memory device.

- **Save to USB (Sel.):** Saves only the filtered error log for the selected channel or input to a USB memory device.

CONFIG menu. Use the CONFIG menu to set various parameters that will generate error reports in the Error Log status display. Some of those parameters are listed below.

- Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, and specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports.

- Use the menu selections under **Alarms** to enable various alarms that will be reported in the log.

- Use the menu selections under **Aux Data Settings** to set various expected data parameters.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

Video Session status display

The Video Session status display contains several performance parameters, such as CRC values, that you can view to get an overview of the video input signal. This instrument maintains a running video status session.
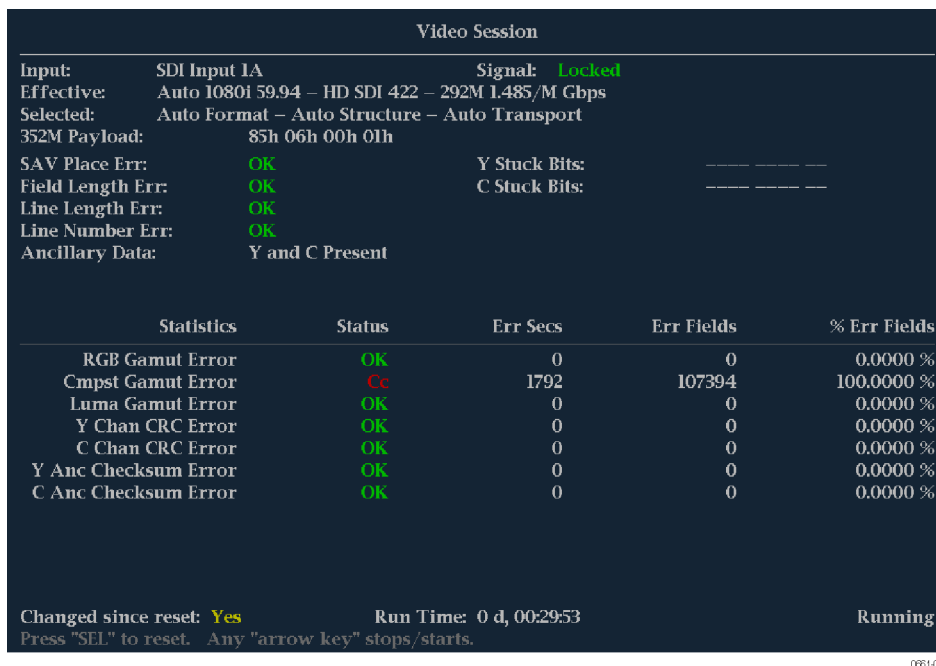
Figure 37: Video Session status display of an HD signal

SDI elements of the Video Session status display. The following elements are visible when SDI 1A or 1B is the selected signal:

- **Input**: Shows the selected input source.

- **Signal**: Indicates whether the instrument is locked to the selected input.

- **Effective**: Shows, in order, the detected format, sample structure, and transport of the input signal.

- **Selected**: Shows, in order, the selected format, sample structure, and transport of the instrument.

- **352M payload**: Indicates the presence of a SMPTE 352M payload.

- **SAV Place Err**: Indicates whether a Start-of-Active-Video Placement Error has occurred.

- **Field Length Err**: Indicates whether a Field Length Error has occurred.

- **Line Length Err**: Indicates whether a Line Length Error has occurred.

- **Ancillary Data**: Indicates whether Ancillary Data is present in the video signal. The displayed values are either Present or None for SD signals, or Y and C Present and None for HD and 3 Gb/s signals.

- **F1 AP CRC**: For SD signals only, calculates and displays the active picture CRC (Cyclical Redundancy Check) for field one in hexadecimal. The instrument uses the SMPTE RP165 standard for error checking. For HD and 3 Gb/s signals, the CRCs change on every video line.

- **F2 AP CRC**: For SD signals only, calculates and displays the active picture CRC (Cyclical Redundancy Check) for field two in hexadecimal. The instrument uses the SMPTE RP165 standard for error checking. For HD and 3 Gb/s signals, the CRCs change on every video line.

- **Data Collect**: Shows the state of error gathering. The possible states are:

  - **Running**: Indicates errors are being gathered and displayed on the status page.

  - **Stopped**: Indicates errors are not being gathered. The status page is not being updated.

  - **Resetting**: Appears briefly after the SEL button is pressed to reset the statistics.

- **Runtime**: The time since the last reset occurred. Time is displayed as "DD, HH:MM:SS", where DD is the number of days, HH is the number of hours, MM is the number of minutes, and SS is the number of seconds.

- **Stuck Bits**: For SD signals only, displays which of the video bits are stuck. If the readout is "—- —- –", then none of the bits are stuck.

- **Y Stuck Bits**: For HD signals only, displays which of the luminance video bits are stuck. If the readout is "—- —- LL", then none of the bits are stuck. LL is displayed for the two unused bits.

- **C Stuck Bits**: For HD signals only, displays which of the chrominance video bits are stuck. If the readout is "—- —- LL", then none of the bits are stuck. LL is displayed for the two unused bits.

- **EDH Error**: For SD signals only, indicates that there is an error in the EDH packet (checksum or parity) of the signal.

- **Statistics**: This section of the display shows the status and statistical values for certain errors. For information about the errors in this section, view the help file in your instrument: while the Video Session is active in a tile, press the HELP button.

- **Status**: Shows the status of the associated error as either OK, Invalid, Missing, or Error.

- **Err Secs**: The number of seconds, since the last reset, that contained at least one error.

- **Err Fields**: The number of fields, since the last reset, that contained at least one error.

    ■   **% Err Fields**: Shows a calculated number showing the percentage of all fields since the last reset that contained at least one error.

    ■   **Black Events**: Shows when a black frame has occurred within the video image. Settings configured in the CONFIG > Measurement Settings menu.

    ■   **Frozen Events**: Shows when a frozen frame has occurred within the video image. Settings configured in the CONFIG > Measurement Settings menu.

    ■   **Changed Since Reset**: Indicates if either the F1 or F2 AP CRC values have changed since the last reset.

    ■   **Frozen**: This readout only appears when you press the CAPTURE button. It indicates that errors are being gathered, but are not being displayed on the Status page. This state is useful for looking at EDH (Error Detection and Handling) CRC (Cyclic Redundancy Check) values on live video.

Status pop-up menu (Video Session display).   Press and hold the STATUS button to open the Status pop-up menu. The following menu selections are available:

NOTE. To reset, stop, or start an individual video or audio session, select the tile in which it is displayed and use the SEL button, right arrow key, and left arrow key, respectively. Remember that the STATUS pop-up menu must be closed; otherwise, the button and key presses will navigate through that menu.

    ■   **Display Type** and **ARIB Display:** Use the arrow keys to select a status display. (See page 84, *To select a status display*.)

    ■   **Mute Alarms:** Mutes alarms for all of the Status display types. An Alarms Muted icon appears in the Status Bar. (See page 37, *Status bar icons*.)

    ■   **All Sessions Reset:** Globally resets any and all video sessions displayed in all panes, regardless of the display and session from which it is executed.

    ■   **All Sessions Start:** Globally starts any and all stopped video sessions displayed in all panes, regardless of the display and session from which it is executed.

    ■   **All Sessions Stop:** Globally stops any and all stopped video sessions displayed in all panes, regardless of the display and session from which it is executed.

CONFIG menu.   Use the CONFIG menu to set the following Video Session status display parameters:

- Use the menu selections under **SDI Input** to set various format, structure, and video signal parameters.

- Use the menu selections under **Alarms** to set various alarms related to video input, content, and format errors.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes.

Timing Measure display

The Timing Measure display a Tektronix proprietary display that simplifies measuring the timing difference between the SDI video input signal and the analog video external reference signal as the timing is corrected. This display enables you to easily compare and correct the timing between two signals.

For this display to operate, signals must be connected to the selected video input and to the external reference input. Use the Waveform display to view the video input waveform and use the External Reference Waveform display to view the external reference signal. (See page 114, *Waveform display*.) (See page 67, *External Reference Waveform display*.)

To access the Timing Measure display

1. Press and hold the **MEAS** button to open the Measure pop-up menu.

2. Use the arrow keys to select **Display Type > Timing Measure**.

3. Press the **MEAS** button to close the pop-up menu.
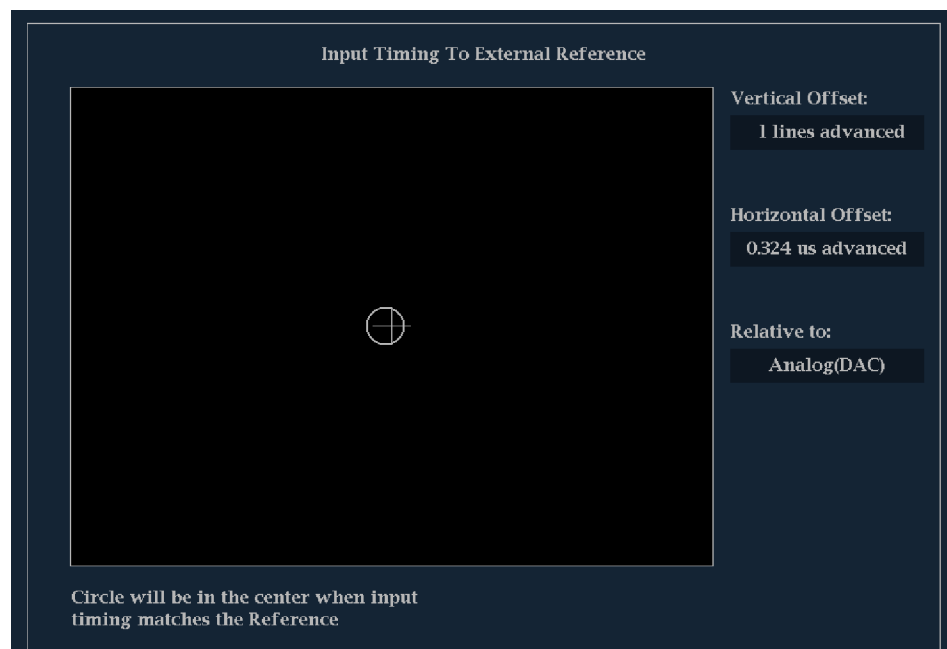
Elements of the Timing Measure display

Figure 38: Timing Measure display

- **Input Signal Indicator:** A single circle representing timing of input signal relative to the reference. [1]

- **Reference Indicator:** A cross-hair indictor centered in the display represents the reference signal.

- **Vertical Offset:** The timing difference between the reference and input signal.

■ **Horizontal Offset:** The timing difference between the reference and input signal.

■ **Relative to:** Indicates the chosen zero point for the timing display. [2]

■ **Link B to Link A:** Indicates the timing relationship between links of a Dual Link signal.

[1] More complex timing relationships display multiple circles. See *Timing displays for simple versus complex timing*. (See page 108.)

[2] If you select *Saved Offset*, you can save the timing from one signal, and then display the timing relative to that saved offset.

Measure pop-up menu (Timing Measure display)

Press and hold the MEAS button to open the Measure pop-up menu. The pop-up menu enables you to save a timing setting so that you can measure the timing between input or to match multiple inputs, and to specify the zero point of the timing display.

Save Offset. Saves the timing of the current input as an offset to the timing display. This saved timing becomes the zero point for the saved offset mode of the timing display. This applies to both the cross-hair target in the middle of the display and the numeric readouts.

The Save Offset function allows you to measure the timing between inputs or to match multiple signals. Use the Relative To setting to select the definition for the zero timing offset.

NOTE. You cannot save the timing offset if either the input or reference is missing or unlocked. You also cannot save a reference when in internal mode. Saving an offset in these conditions would lead to misleading results so it is not allowed by the instrument. A warning message appears on the screen if you attempt to save the offset when it is not allowed.

Relative To. Sets the definition for the zero timing offset to one of the following. This selection changes both the numeric readouts and the target in the middle of the timing display.

■ **Analog (DAC)**: Means the timing offset of SD and HD SDI inputs are compensated for the delay of a nominal D to A converter. So after accounting for the DAC, the delay will be shown as zero when the two signals are timed down at the top panel of the instrument.

　The DAC delay is not applied to composite or 3 Gb/s SDI inputs, so the Analog (DAC) and Serial (OH) settings are equivalent for these inputs.

■ **Serial (OH)**: Means the timing offset of the serial stream is considered to be zero when the "OH" sample of the scrambled serial stream is coincident with the appropriate sync edge of the analog reference connected to the instrument.

　This setting is also allowed for composite inputs where this selection for zero timing means the reference sync points of the two signals will be coincident at the top panel of the instrument.

■ **Saved Offset**: Means that the timing will be shown as zero offset when the input signal matches the timing of the signal that was present when the offset was saved using the Save Offset menu entry.

Timing displays for simple versus complex timing

The number of circles, with each representing a time offset, varies with the complexity of the timing between the reference and input signals.

Integer multiples of reference rates. If you are timing input signals with rates that are integer multiples of the reference rates, the instrument can measure the timing deterministically and displays the relationship as one circle (offset) relative to the cross-hair. (See Figure 38 on page 106.)

Such cases include timing an NTSC input (multiplier of 1) or a 525 SDI input whose frame time is 33.36 ms (multiplier of 2), against an NTSC reference, which has a frame time of 66.73 ms.

Non-integer multiples of reference rates. If you time input rates that are not integer multiples of the reference rates, the instrument cannot measure the timing deterministically, so it displays the relationships as several circles. Each circle represents a possible timing offset measurement relative to the reference cross-hair. Display emphasis is given to the circle that times closest to zero offset and the numerical readouts track this pair. (See Figure 39.)
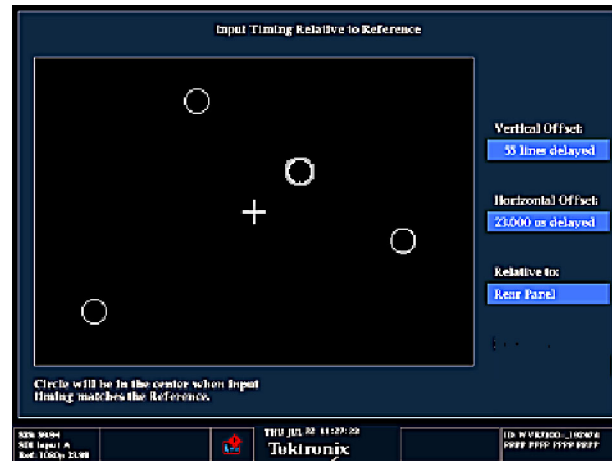
Figure 39: Timing display of non-integer multiples of reference rates

Non-deterministic cases include timing of slow rate inputs against fast frame-rate references or when timing video against film rates.

Multiple relationships. For a case where multiple relationships would display, consider an input of 1080p/23.98 Hz with a reference of NTSC/59.94 Hz:

■   The different rates result in timing relationships between the signals that repeat once for every four fields of the input and five frames of the reference.

■   Because this allows for five possible ways to measure timing between these two signals, the timing display shows four circles, with emphasis and readouts as previously described above.
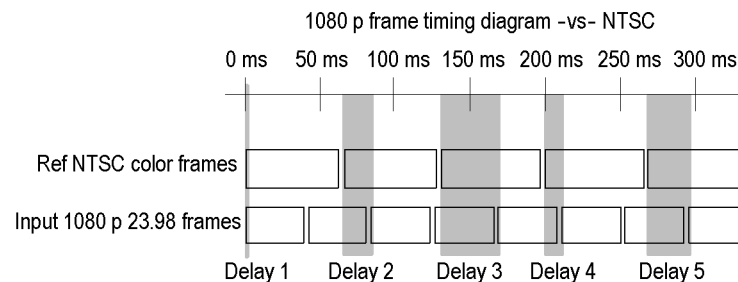
Vector display

The Vector display is a plot of the Pr signal on the vertical axis and the Pb signal on the horizontal axis. This display is useful for looking at hue and amplitude of the colors, but does not show luminance information.

You can set the color bar targets to 75% or 100%, select which color is at the center of the display, and display the SDI signal as if it were a composite signal.

The related Lightning display plots the Pr and Pb color signals against luminance, which is useful for checking chroma and luma gain and for checking chroma to luma delay. (See page 74, *Lightning display*.)

To access the Vector display

1. Press and hold the **VECTOR** button to open the Vector pop-up menu.

2. Use the arrow keys to select **Display Type > Vector**.

3. Press the **VECTOR** button to close the pop-up menu.

Elements of the Vector display
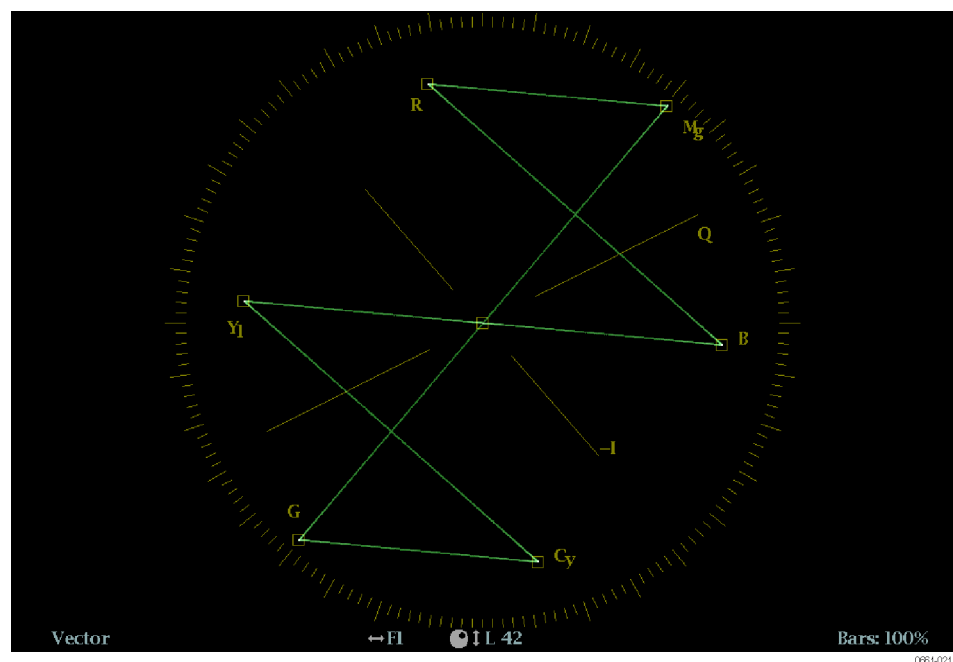
Figure 40: Vector display in Normal mode with the compass rose and I/Q axis graticules enabled

0661-022
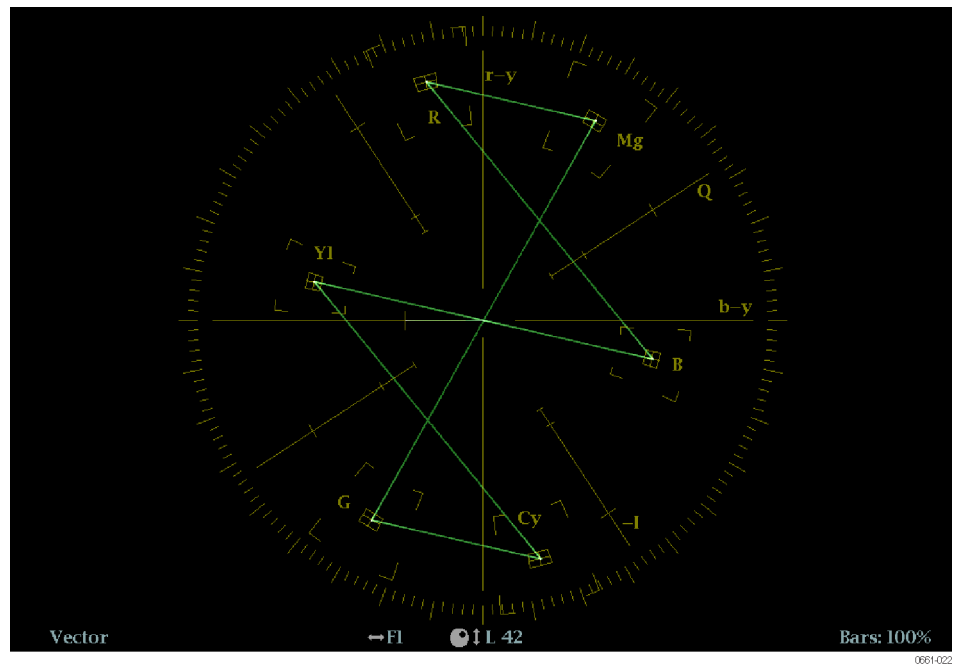
Figure 41: Vector display in Composite mode

The following elements appear on the display:

- **V Gain:** Shows the current gain setting when the gain is other than 1x. Press the GAIN button to toggle the vertical gain between 1x and the most recently selected gain value. Gain is applied equally in the horizontal and vertical directions.

  Press and hold the GAIN button to select fixed gain settings (1x, 2x, 5x, or 10x) or to enable VAR Gain mode. If you enable VAR Gain mode in the Gain pop-up menu or by pressing the VAR button, you can adjust the gain using the General knob.

- **Display Type:** The selected display, either Lightning or Vector.

- **Bar Target Setting:** The bar target setting, either 75% or 100%.

- **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

- **H** and **V** positions: When you press the POS button to adjust the position of the waveform, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

- **Compass rose graticule:** When the Vector display mode is set to normal, the compass rose graticule appears only when it is enabled in the CONFIG > Graticules & Readouts submenu. When the Vector display mode is set to Composite, the compass rose graticule always appears.

- **I/Q axis graticule:** When the Vector display mode is set to normal, the I/Q axis graticule appears only when it is enabled in the CONFIG > Graticules & Readouts submenu. When the Vector display mode is set to Composite, the I/Q axis graticule always appears.

Vector pop-up menu   The Vector pop-up menu enables you to specify the display type and display mode (SDI inputs only), to set the bar targets, and to center the waveform in the display. The following menu selections are available:

Display Type.   Select from the following display types:

- **Vector** – The Vector display shows a plot of the Pr signal on the vertical axis and the Pb signal on the horizontal axis. This display is useful for looking at hue and amplitude of the colors, but does not show luminance information.

- **Lightning** – This Tektronix proprietary display shows the same Pr and Pb color signals as in the Vector mode, but they are plotted against luminance. The Lightning display is useful for checking chroma and luma gain, and for checking chroma to luma delay using the timing marks that show errors in the green to magenta transition on a color bar signal. (See page 74, *Lightning display*.)

Bar Targets.   Select which scaling (75% or 100%) will be used in the active tile for either the Vector or Lighting display.

Center on.   To center the Vector display on a specific color, use the arrow keys to select the desired color. Select Black to restore the trace to the default position at the center of the tile.

Display Mode.   Select from the following compass rose display modes:

- **Normal** – Sets the compass rose and signal representations to component. The compass rose graticule must be turned on in the CONFIG > Graticules & Readouts menu before the compass rose will be visible in this mode.

- **SDI > Composite** – Sets the compass rose and signal representations to composite. The composite representation is independent from the Colorimetry in the signal source and provides a uniform representation of the hue shift.

CONFIG menu   Use the CONFIG menu to set the following Vector display parameters:

- Set the **SDI Input > HD Colorimetry** setting to **Auto**, **ITU 709-2**, or **SMPTE 240M** to set the expected colorimetry in HD signals.

- Set the **Graticules & Readouts > Vector I/Q Axis** setting to **On** or **Off** to turn on or off the I and Q axes on the display.

- Set the **Graticules & Readouts > Vector Compass Rose** setting to **On** or **Off** to turn on or off the compass rose display.

- Set the **Graticules & Readouts > Vector Readouts** setting to **On** or **Off** to turn on or off the readouts on the display.

- Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity and graticule color.

To position the   To adjust the position of the trace on the Vector display:
Vector trace
1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout. (See page 114, *Elements of the Waveform display*.)

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

Waveform display

The Waveform display is a voltage versus time display of the SDI video signal. You can view the signal in line or field sweep, choose which SDI signal elements are displayed (RGB, YRGB, or YPbPr), and apply filters to the signal.

You can also display the SDI signal as if it were a composite signal and control (from the CONFIG menu) whether the EAV, SAV, and ANC data is included in the display.

To access the Waveform display

1. Press and hold the **WFM** button to open the Waveform pop-up menu.

2. Use the arrow keys to select **Display Type > Waveform**.

3. Press the **WFM** button to close the pop-up menu.

Elements of the Waveform display
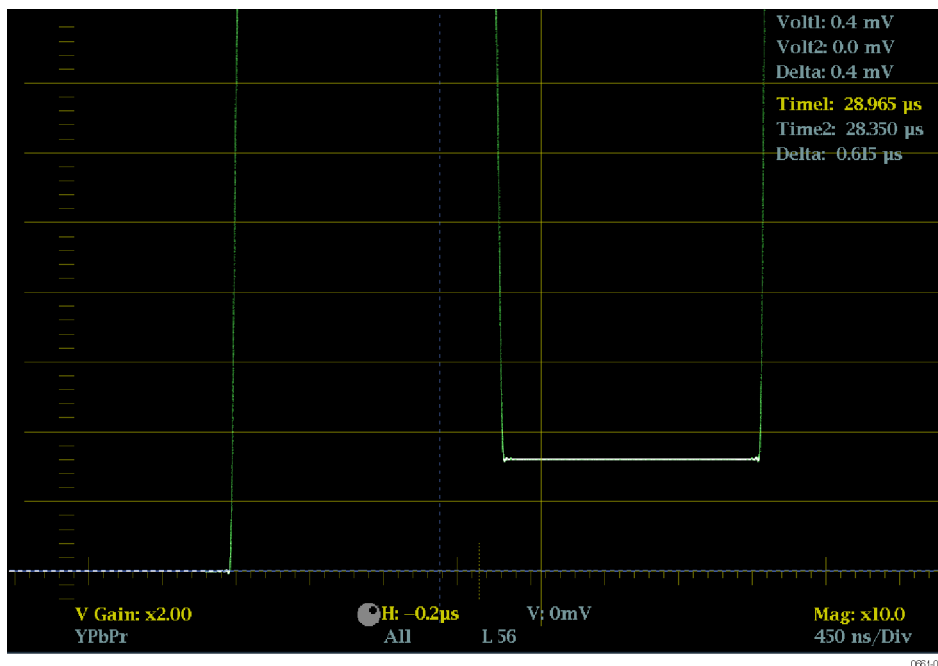
The following elements appear on the display:

- **V Gain:** Shows the current vertical gain setting when the gain is other than 1x. Press and hold the GAIN button to select a vertical gain setting. (See page 117, *MAG, GAIN, SWEEP, and CURSOR buttons.*)

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■ **Mag:** Shows the current horizontal magnification factor when the magnification is other than 1x. Press and hold the MAG button to select a magnification factor. (See page 117, *MAG, GAIN, SWEEP, and CURSOR buttons*.)

■ **Horizontal axis units:** Shows the units for the tick marks on the 0 mV axis of the graticule. The axis units change depending on the sweep and magnification settings and the video input format.

■ **Color space:** Shows the currently displayed waveform color space. Dashes (–) indicate components not displayed.

■ **H** and **V** positions: When you press the POS button to adjust the position of the waveform trace, a position readout appears with a knob icon to indicate whether the horizontal or vertical position is the focus of the General knob.

■ **Field and line numbers:** Shows the currently selected video field and line numbers when Line Select mode is enabled. (See page 125, *Line select*.)

■ **Volt1, Volt2, Time1, Time2,** and **Delta:** Shows the current position of the voltage or time cursors and the distance between them when the cursors are enabled. (See page 117, *MAG, GAIN, SWEEP, and CURSOR buttons*.)

Waveform pop-up menu (Waveform display)

Press and hold the WFM button to open the Waveform pop-up menu. The pop-up menu enables you to configure the display type, style, and mode used in the selected Waveform tile. The following menu selections are available:

Display type. Select from the following display types:

■ **Waveform** - Displays a voltage versus time plot of the selected SDI input signal (SDI A or SDI B).

■ **LTC Waveform** - Displays a voltage versus time plot of the LTC input signal (LTC IN). (See page 77, *LTC Waveform display*.)

■ **Ref Waveform** - Displays a voltage versus time plot of the external reference input signal (REF IN). (See page 67, *External Reference Waveform display*.)

Display style. Select the style for how the SDI signal components are displayed:

■ **Parade** - has all the components shown one beside the other.

■ **Overlay** - has all the components drawn at the same location so that they appear one on top of the other.

Y, R, G, B components. Select to turn on or off the display of the individual video components: Luma (Y), Red (R), Green (G), or Blue (B).

Display mode. Select from the following display modes:

■ **YPbPr** - Displays the SDI video input as Luma (Y) and color difference (Pb, Pr) components.

■ **YRGB** - Displays the SDI video input as Luma (Y), Red (R), Green (G), and Blue (B) components.

■ **RGB** - Displays the SDI video input as Red (R), Green (G), and Blue (B) components.

■ **SDI** > **Composite** - Displays the SDI video input as if it is encoded into composite. The sync and burst in this mode are synthetic and convey no information about signal quality.

  When viewing 525-line SDI input as a composite waveform in Line Select mode, both burst phases may appear when you would expect to see only one. This is because the line selection in SDI Mode is an odd/even selection, and composite signals are normally viewed with a one-of-four or one-of-eight line selection.

Filter. Select a filter to be applied to the video signal. This is useful for isolating a specific characteristic of the input. For example, to measure amplitude, you may want to use a Luma or Low pass filter to remove the high frequency components.

To choose a filter select one of the following filters from the Waveform menu:

■ **Flat** - Display with the full available bandwidth.

■ **Luma** or **Low Pass** - Display only the low-frequency part of the signal.

Center waveform. Select this option to cancel any horizontal or vertical position adjustments and restore the trace to the default position. This puts the baseline at the zero graticule.

CONFIG menu   Use the CONFIG menu to set the following Waveform display parameters:

■ Set the **Graticules & Readouts > SDI Waveform Vertical Area** setting to **Normal** or **Max** to set the vertical limits of the display area.

■ Set the **Graticules & Readouts > SDI Waveform Graticules** setting to **Normal** or **Percent** to set the measurement units for the vertical axis.

■ Set the **Graticules & Readouts > Waveform Readouts** setting to **On** or **Off** to turn on or off the readouts on the Waveform display.

■ Use the menu selections under **Display Settings** to set various general display parameters which affect all applicable display modes such as waveform intensity, graticule color, and enabling the thumbnail view.

MAG, GAIN, SWEEP, and CURSOR buttons

The MAG, GAIN, SWEEP, and CURSOR buttons provide functions that affect the display.

MAG button. Press the MAG button to toggle the magnification factor between 1x and the most recently selected magnification factor. Press and hold the MAG button to select fixed magnification factors (10x, 20x, 25x, or 50x) or to enable Best View mode.

In Best View mode, the horizontal magnification factor depends on the current sweep mode. For 1-field and 2-field modes, the magnification is optimized to show the blanking intervals. For 1-line and 2-line modes, the magnification is 20x or 25x to achieve a reasonable scale factor.

GAIN button. Press the GAIN button to toggle the vertical gain between 1x and the most recently selected vertical gain value. Press and hold the GAIN button to select fixed gain settings (1x, 2x, 5x, or 10x) or to enable Var Gain mode. If you enable VAR Gain mode in the Gain pop-up menu or by pressing the VAR button, you can adjust the vertical gain using the General knob.

SWEEP button. Press the SWEEP button to toggle the sweep between 1 Line and the most recently selected sweep mode. Press and hold the SWEEP button to select the display style (Parade or Overlay) and to select the sweep mode (1 Line, 2 Line, 1 Field, or 2 Field).

CURSOR button. Press the CURSOR button to toggle the measurement cursors on and off. Press and hold the CURSOR button to select the cursor style (Voltage, Time, or Voltage + Time) and to select the voltage cursor units (mV or %).

To position the Waveform trace

To adjust the position of the trace on the Waveform display:

1. Press the **POS** button.

2. Press the left or right arrow key to enable horizontal or vertical adjustments. The knob icon appears next to the selected adjustment readout. (See page 114, *Elements of the Waveform display*.)

3. Turn the General knob or use the up/down arrow keys to adjust the position of the waveform.

4. Press the **POS** button to turn off the position adjustment mode.

Functions

This section describes the following functions of the instrument:

- Gain, sweep, and magnification

- Measurement cursors

- Display capture

- Line selection

- Audio volume and source adjustment

- Presets

- Software upgrades

Gain, sweep, and magnification

Select the gain, sweep, and magnification settings of a displayed trace using the GAIN, VAR, SWEEP, and MAG buttons. These front-panel buttons illuminate when the associated function is active.

NOTE. The gain, sweep, and magnification functions do not apply to all of the display types. The applicable display types for each function are listed below.

To set the gain   The gain function applies only to the Waveform, LTC Waveform, External Reference Waveform, Vector, Lightning, and Bowtie displays. The gain settings for each display type are independent of each other.

For the Vector display only, the gain is vertical and horizontal. For the other display modes, the gain is vertical only.

Gain is composed of both fixed and variable gain components. The effective gain is the fixed gain multiplied by the variable gain. Fixed gain affects both the trace and graticule. Variable gain affects only the trace.

The default gain setting is 1x. You can use the Gain pop-up menu to select one of the available fixed gain settings (such as 2x, 5x, and 10x) or you can enable variable gain mode and manually set the gain.

To select a fixed gain setting. Select a fixed gain setting by performing the following actions:

1. Press and hold the **GAIN** button to display the Gain pop-up menu.

2. Use the arrow keys to select **Gain Settings**, and then select one of the available fixed gain settings. The GAIN button stays illuminated when a fixed gain setting other than 1x is selected.

3. After you press the **GAIN** button to close the pop-up menu, you can then press the **GAIN** button again to toggle the gain between 1x and the last selected gain setting.

To select a variable gain setting. Select a variable gain setting by performing the following actions:

1. Enable variable gain using one of the following methods. The VAR button illuminates when variable gain is enabled.

   − Press the **VAR** button.

   − Press and hold the **GAIN** button to display the Gain pop-up menu. Use the arrow keys to select **VAR Gain > Enable**, and then press the **GAIN** button to close the pop-up menu.

2. Use the General knob or the up/down arrow keys to adjust the gain.

3. Press the **VAR** button to toggle the gain between the fixed gain setting and the selected variable gain setting.

NOTE. When variable gain is enabled and a gain setting other than 1x is also selected (GAIN and VAR buttons are illuminated), the gain settings are multiplied together. For example, if variable gain is enabled and set to 1.2x, and a fixed gain of 5x is also selected, the displayed gain will be 6x (5 x 1.2).

*When both gain and variable gain are enabled, press the **GAIN** or **VAR** buttons to toggle the portion of the gain associated with that button on and off.*

To set the sweep rate
The sweep function applies only to the Waveform, External Reference Waveform, and Bowtie displays. The sweep settings for each display type are independent of each other.

The default sweep setting is 1 Line. You can use the Sweep pop-up menu to select one of the available sweep settings:

1. Press and hold the **SWEEP** button to display the Sweep pop-up menu.

2. Use the arrow keys to select a line or field sweep. The available sweep options depend on which display mode is active.

    For example, when the Waveform display is in Overlay mode, you can select from 1 Line, 2 Line, 1 Field, or 2 Field sweeps. When that same display is in Parade mode, only 1 Line and 1 Field sweeps are available.

3. After you press the **SWEEP** button to close the pop-up menu, you can press the **SWEEP** button again to toggle the sweep between 1 Line and the last selected sweep setting.

To set the horizontal (sweep) magnification

The magnification function applies only to the Waveform, Lightning, Bowtie, and ANC Data displays. The magnification settings for each display type are independent of each other.

Set the Waveform, Lightning, or Bowtie horizontal (sweep) magnification. The default magnification setting is 1x. Select a magnification setting by performing the following actions:

1. Press and hold the **MAG** button to display the Magnification pop-up menu.

2. Use the arrow keys to select a magnification setting. The available magnification options depend on which display mode is active:

   - For the Waveform and Bowtie displays, you can select from Best View, 10x, 20x, 25x, or 50x. The Best View setting optimizes the magnification for the selected sweep mode. For 2 Line and 2 Field sweeps, the magnification is optimized to show the blanking intervals. For 1 Line and 2 Line sweeps, the magnification is optimized to achieve a reasonable scale factor.

   - For the Lightning display, the magnification controls H Gain (horizontal gain). You can select from 2x, 5x, or 10x fixed magnifications and you can enable Variable H Gain and then use the General knob or the up/down arrow keys to adjust horizontal variable gain.

3. After you have selected a magnification setting, press the **MAG** button to close the pop-up menu.

4. You can now press the **MAG** button to toggle the magnification between 1x and the last selected magnification setting.

NOTE. For the Lightning display only, when variable H Gain is enabled and a magnification setting other than 1x is also selected, the magnification settings are multiplied together. For example, if variable H Gain is enabled and set to 1.2x, and a fixed magnification of 5x is also selected, the displayed H Gain magnification will be 6x (5 × 1.2).

Set the ANC Data display magnification. When the ANC Data display is selected, press the **MAG** button to toggle the size of the user-data display area.

The magnification function for the ANC Data display allows you to see more of the user data at the bottom of the display or to see more of the listed data types at the top of the display.

Measurement cursors (Waveform display only)

The measurement cursors are available only for the Waveform display. The cursors enable you to accurately measure desired portions of the displayed waveform.

Cursor types   There are two types of measurement cursors:

■   **Time:** There are two cursors for measuring time along the horizontal axis of the waveform.

■   **Voltage:** There are two cursors for measuring voltage levels along the vertical axis of the waveform. You can set the units for the voltage cursors to be either millivolts or percentage. When the cursors units are set to percentage, you can set the current cursor position to be the 100% level.

The cursor readouts display the current position of each cursor and also the difference between them. (See Figure 42.)

To display and adjust the cursors   Perform the following steps to display and adjust the measurement cursors in the Waveform display:

1.   Select which cursors to display and set the cursor units:

   a.   Press and hold the **CURSOR** button to open the Cursor pop-up menu.

   b.   Use the arrow keys to set the **Cursor Style** to one of the following:

      –   **Voltage:** Displays only the two voltage cursors.

      –   **Time:** Displays only the two time cursors.

      –   **Voltage + Time:** Displays both the voltage and time cursors.

   c.   For voltage cursors only, use the arrow keys to set the **Voltage Cursor Units** to one of the following:

      –   **mV:** Sets the cursor units to millivolts.

      –   **%:** Sets the cursors units to percentage.

   d.   Press the **CURSOR** button once to close the pop-up menu. The enabled measurement cursors will be displayed and the CURSOR button will remain illuminated.

2. Use one of the following methods to select which measurement cursor to adjust. A knob icon appears next to the selected measurement cursor to indicate that the knob focus is set to that cursor.

NOTE. If the knob icon does not appear next to a cursor measurement, press the CURSOR button to assign knob control to the cursors (make the cursors active).

- If only voltage cursors are enabled or if only time cursors are enabled, press any arrow key to select between the two displayed measurement cursors.

- If voltage cursors and time cursors are both enabled, press the up/down arrow keys to select between the two voltage cursors, and press the left/right arrow keys to select between the two time cursors.

3. Turn the **GENERAL** knob to adjust the position of the selected cursor. The active cursor readout appears in yellow.

*NOTE. To quickly center the active cursor on screen, press and hold the **SEL** button.*

If the voltage cursor units are set to percentage, you can use the Cursor pop-up menu to set the current position of the selected voltage cursor to be 100%.

4. Repeat steps 2 through 3 to adjust the position of the other enabled cursors.

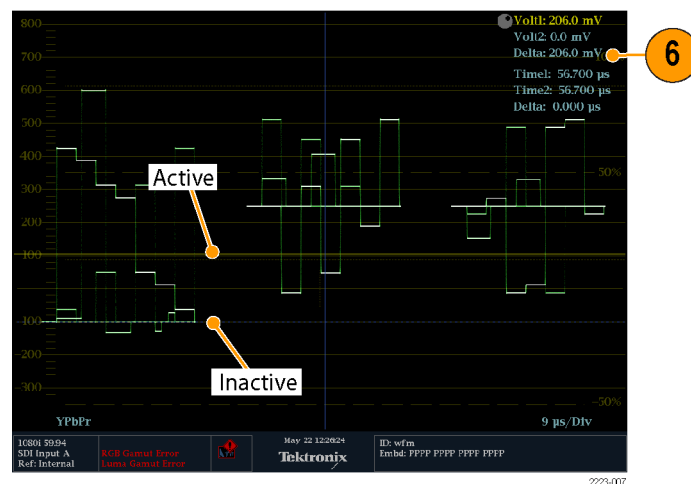5. Read the cursor measurements in the Cursors readout.

Figure 42: Using measurement cursors in the Waveform display

Display capture (freeze)

The capture (freeze) function essentially lets you take a snapshot of the display. Use the **CAPTURE** button to perform the following tasks:

- Freeze a single tile

- Freeze all tiles simultaneously

NOTE. The frozen information is lost when the instrument power is cycled.

Use the CONFIG > Display Settings > Freeze Affects submenu to configure the freeze function to capture all of the displayed tiles or to only capture the active (selected) tile.

The freeze function works in both 4-tile and full-screen modes but does not transfer when you change modes. For example, if you freeze a trace in 4-tile mode, the frozen image will not be shown if you go to full-screen mode. The image will still be available if you go back to 4-tile mode.

If you freeze an image in a tile and then switch that tile to another display mode (such as Vector), the frozen image is hidden. If you then change the tile back to the original display mode type, the frozen image will reappear.

NOTE. For waveform displays, the captured image is shown in a different color to distinguish it from the live image. For all displays, the instrument continues to log error status in the background while the display is captured.

Remote screen capture   You can also use the instrument remote interface to capture a snapshot of the instrument display or status bar in BMP or PNG formats. To connect to the remote interface, enter the IP address of the instrument into the URL address bar of a Web browser.

Before you can connect to the remote interface, use the CONFIG > Network Settings > Web Enable submenu to enable access to the remote interface.

Line select

The Line Select function allows you to select which video line to view in the Waveform, Vector, Lightning, Arrowhead, Diamond, Split Diamond, Bowtie, and Datalist displays.

NOTE. In the Picture display, the selected video line is highlighted in the picture image when the Picture Line Select Cursor is enabled in the CONFIG > Graticules & Readouts submenu.

In full screen mode, when you enable Line Select and select a video line in one display (for example, the Waveform display), if you then select another applicable display type using the display-mode buttons (for example, the VECTOR button), the new display will automatically view the same video line. If you select another display mode using the DISPLAY SELECT button, you will have to enable Line Select for that display mode to view the same video line.

In 4-tile mode, you must enable Line Select for each applicable display type. When enabled, each applicable display type will show the same video line. If the Waveform display is set to field sweep and it is one of the display modes in a 4-tile display, the selected video line is highlighted in the field sweep when the Field Sweep Line Select Cursor is enabled in the CONFIG > Graticules & Readouts submenu.

Perform the following steps to select a video line to view:

1. Select the tile containing the display for which you want to enable Line Select.

NOTE. Line Select Mode can only be active on one tile at a time, but the line select brightup cursor does appear in other tiles and moves as you select lines in the active tile.

2. Press the **LINE SEL** button to toggle Line Select on or off. When on, the tile displays the selected line information only.

3. Press the left or right arrow key to select **F1** (field 1), **F2** (field 2), or **All**. (See Figure 43.)

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*NOTE. For dual link signals in fast progressive video formats, use the arrow keys to select **Link A** or **Link B**.*

*In the Datalist display, press the **SEL** button to toggle between Line Select and Sample Select.*

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4. The line and field information will appear at the bottom of the display screen.

5. Use the General knob or the up/down arrow keys to select a video line to view.
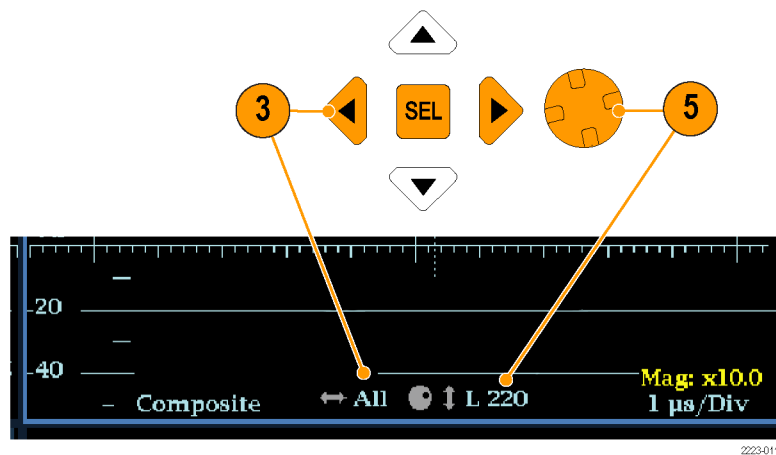

Figure 43: Navigating line selection

Audio volume and source adjustment

To listen to the audio in an input signal, the instrument provides internal speakers and a headphone jack, which is located on the right side panel. When headphones are connected to the instrument, the internal speakers are muted.

⚠️ *WARNING. To prevent the risk of hearing damage, always turn down the audio volume before connecting headphones to the headphone jack. Sound levels and impedance can vary between different headphones.*

To adjust the audio volume
You can use any of the following methods to adjust the volume of the audio played out on the instrument speakers or the headphone jack:

- When the Audio display is selected and no menus are active, turn the General knob.

- When a display mode other than Audio is selected, press the **VOL** button and then use the General knob or the up/down arrow keys.

- Select the **CONFIG > Audio Inputs/Outputs > Headphone Volume** submenu item and then use the General knob or the up/down arrow keys.

- At any time, press and hold the **VOL** button to toggle audio muting. A red "X" appears over the speaker icon in the Status Bar when audio is muted.

NOTE. When monitoring high-amplitude audio, volume levels over 90% may cause audio clipping.

To select the audio source
You can use the following methods to select the source of the audio played out on the instrument speakers or the headphone jack:

- When the audio input is embedded, press the **INPUT A** or **INPUT B** buttons to set the audio source to be from the SDI A or SDI B video input signal.

- When the Audio display is selected, use the Audio pop-up menu to set the Audio Input source to be from the embedded audio on the selected video input or to be from the AES audio input.

Presets

Instrument setups can become complex as you tailor them to monitor various parameters. To save set up time and ensure consistency, you can save instrument setups as presets in your instrument. You can save and quickly access presets using the **PRESET** button on the instrument front-panel and from the instrument Web page.

All instrument settings except those set in the Utilities and Network Settings submenus of the Configuration menu are saved in a Preset. Settings that are not saved are those such as the clock setting, IP configuration, and network address. The following is an overview of the settings saved in a Preset:

- Measurement assigned to each tile

- Tile specific settings

- Input selection

- SDI Input settings

- External Reference settings

- Audio Displays settings

- Audio Inputs/Outputs settings

- Alarm settings

- Gamut thresholds

- Display settings

- Readout setting

- Graticule settings

Preset groups The instrument can store up to 32 separate instrument presets. The presets are divided into four groups, A through D, with each group containing 8 preset storage locations. By default, the presets are named after their storage location (A1 – A8, B1 – B8, C1 – C8, and D1 – D8).

When the instrument is in Preset mode, the display mode buttons under the LCD display (WFM, VECTOR, PICT, etc.) illuminate and serve as the selection buttons for the storage locations within the selected preset group. Also, the contents of the Status Bar are replaced by boxes representing each preset in the selected group. If a preset location in that group has been saved, the box representing that location contains the name of the saved preset. Preset locations that have not been saved are indicated by <empty> in blue text.

In Preset mode, only one group of presets can be displayed at a time. Use the Preset pop-up menu to select which preset group (A – D) will be displayed when the instrument is in Preset mode. You can use the Preset pop-up menu to directly access any preset group and location.

To save presets Perform the following steps to save the current instrument settings as a preset:

1. Set up the instrument exactly as you want to have it configured. This includes setting the contents of each tile and the audio and video settings.

2. Press and hold the **PRESET** button to open the Preset pop-up menu.

3. Use the arrow keys to select **Save Preset** and then to navigate to the desired preset location. For example, select Save Preset > Select Group B > Save B1.

4. Press the **SEL** button to save the preset. A message displays that your preset is saved.

5. Press the **PRESET** button to close the pop-up menu.

NOTE. Once you have saved various instrument configurations as presets on one instrument, you can export the saved presets to a USB device so that you can import them to another instrument. (See page 131, To export presets to aUSB device.)

To rename groups or presets By default, the preset groups are named A through D and each preset is named after the storage location (A1 – A8, B1 – B8, C1 – C8, and D1 – D8). To rename a preset group or a preset to a meaningful name, perform the following steps:

1. Press and hold the **PRESET** button to open the Preset pop-up menu.

2. Use the arrow keys to select **Rename Preset** and then to navigate to the desired group and preset location. For example, select Rename Preset > Select Group B > Rename B1.

3. Press the **SEL** button or the right arrow key to open the Rename Preset edit box.

4. Use the left/right arrow keys to select a character in the name, and then use the up/down arrow keys to set the value of the selected character. Repeat for each character in the name.

5. After you have edited the name, select the **Accept** box and press the **SEL** button.

6. Repeat steps 2 through 5 for each preset or group that you want to rename.

7. Press the **PRESET** button to close the pop-up menu.

To recall presets   There are three methods for recalling saved presets:

■ Press the **PRESET** button, and then use the display mode buttons under the LCD display (WFM, VECTOR, PICT, etc.) to select a preset from the displayed preset group.

■ Press and hold the **PRESET** button to open the Preset pop-up menu, and then use the arrow keys to select a saved preset from any of the four preset groups or to recall the factory default preset. Press the **SEL** button to activate the selected preset.

■ Use the Preset pop-up menu to select which preset is activated when the instrument is powered on.

To configure the power on preset.   Perform the following steps to select which instrument preset is activated when the instrument is powered on:

1. Press and hold the **PRESET** button to open the Preset pop-up menu.

2. Use the arrow keys to select **Power Up Setup**. The name of the currently selected power on preset is displayed in blue text.

3. Use the arrow keys to navigate to the desired preset. For example, select Power Up Setup > Select Group B > Select B1.

NOTE. You can select any saved preset from any of the four preset groups, or the factory default preset, or the last state of the instrument when it was powered down to be the power on preset.

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4. Press the **SEL** button to select the preset. The name of the selected power on preset is displayed in blue text.

5. Press the **PRESET** button to close the pop-up menu.

To export presets to a USB device

Once you have saved various instrument configurations as presets on an instrument, you can export the saved presets to a USB device so that you can import them to another instrument.

The instrument saves the presets to the subfolder you specify in a root directory folder named WfmPrst on the USB device.

Perform the following steps to export the saved presets to a USB device:

1. Insert a USB memory device into the USB port located on the top panel of the instrument.

2. Check that the USB memory device mounted properly:

   a. Press the **MAIN** button to open the Main pop-up menu.

   b. Use the arrow keys to select **USB Status**, and then press the **SEL** button.

   c. Check that the Device State is **Mounted**, and then press the **SEL** button.

   d. Press the **MAIN** button to close the Main pop-up menu.

3. Press and hold the **PRESET** button to open the Preset pop-up menu.

4. Use the arrow keys to select **Export Presets** and then **Select Source**.

5. Select one of the following preset sources, and then press the **SEL** button to select the preset source.

   - **Select All:** Selects all of the presets in the instrument.

   - **Select Group A – D:** Selects all of the presets in the selected preset group.

   - **From Group A – D:** Selects a single preset from any of the four preset groups.

6. Use the arrow keys to select **Export Presets** and then **Select Dest**.

7. Select a folder on the USB memory device if one exists or create a new folder by selecting **Create USB Folder** and then using the Create USB Folder edit box to name the new folder.

NOTE. The instrument saves the presets to the subfolder you specify in a root directory folder named WfmPrst on the USB device. If the WfmPrst folder does not exist on the USB device, no folders will be shown as available in the Preset menu. When you select Create USB Folder, the WfmPrst root directory is automatically created during the save process if the directory does not already exist on the USB device.

After you specify a subfolder on the USB device, you must then select the appropriate preset destination folder. The list of available preset destination folders depend on the source settings.

8. In the same Select Dest submenu, navigate to the desired destination folder and press the **SEL** button.

9. Press the left arrow key and then the down arrow key to highlight **Copy**.

10. Press the **SEL** button. You should see a pop-up message that says **Preset Export Complete** after the copy-to-USB function is complete.

11. If you do not want to export any other presets at this time, select **Export Presets** and then select **USB Unmount**.

⚠️ *CAUTION. To prevent a loss of data on the USB device, use the Main menu or the Preset pop-up menu to unmount the USB device before removing it from the instrument.*

12. When the USB Unmount menu selected disappears, remove the USB memory device from the USB port on the instrument.

13. Press the **Preset** button to close the Preset pop-up menu.

14. Perform the import presets procedure to import the saved presets to another WFM2200 instrument. (See page 132, *To import presets from a USB device*.)

To import presets from a USB device

After you have saved the presets from one instrument to a USB memory device, perform the following steps to import those saved presets to another instrument:

NOTE. The instrument imports presets from subfolders in a root directory folder named WfmPrst on the USB device.

1. Insert the USB memory device onto which you saved presets from one WFM2200 into the USB port of another WFM2200.

2. Check that the USB memory device mounted properly:

    a. Press the **MAIN** button to open the Main pop-up menu.

    b. Use the arrow keys to select **USB Status**, and then press the **SEL** button.

    c. Check that the Device State is **Mounted**, and then press the **SEL** button.

    d. Press the **MAIN** button to close the Main pop-up menu.

3. Press and hold the **Preset** button to open the Preset pop-up menu.

4. Use the arrow keys to select **Import Presets** and then **Select Source**.

5. Use the arrow keys to select **Select USB Folder** and then highlight the folder on the USB device that contains the presets exported from another WFM2200. Press the **SEL** button to select the preset folder.

6. Select from the following preset sources, and then press the **SEL** button to select the preset source.

    ▬ **Select All:** Selects all of the presets in the USB folder.

    ▬ **Select Group A – D:** Selects all of the presets in the USB folder from the selected preset group.

    ▬ **From Group A – D:** Selects a single preset from any of the four preset groups.

7. Use the arrow keys to navigate to the **Select Dest** menu option and use the arrow keys to access the submenu.

8. Navigate to the preset group that matches the source preset group and press the **SEL** button.

9. Press the left arrow key and then the down arrow key and highlight **Copy**.

10. Press the **SEL** button. You should see a pop-up notice that says **Import Presets Complete**.

11. If you do not want to export any other presets at this time, select **Import Presets** and then select **USB Unmount**.

⚠ *CAUTION. To prevent a loss of data on the USB device, use the Main menu or the Preset pop-up menu to unmount the USB device before removing it from the instrument.*

12. When the USB Unmount menu selected disappears, remove the USB memory device from the USB port on the instrument.

13. Press the **Preset** button to close the Preset pop-up menu.

Software upgrades

Tektronix releases software updates for products to add new features and to fix software problems. You can find the latest software for your product at the Tektronix Web site (www.tektronix.com/software).

Before you begin

Perform the following steps to determine if the software on your instrument should be upgraded:

1. Power on the instrument.

2. Verify the current software version installed on the instrument:

    a. Press the **CONFIG** button on the front panel.

    b. Navigate to **Utilities** > **View HW/SW Version**.

    c. In the Hardware and Software Versions display window, note the software version number of the instrument.

WFM2200 software version number	

3. Verify the latest version of software at the Tektronix Web site:

    a. Use the Web browser on a computer to navigate to the following Tektronix Web site:

        `http://www.tektronix.com/downloads`

    b. On the Downloads Finder Web page, search by model number (such as WFM2200) and filter by software and software type to locate the software-upgrade package for the instrument.

    c. Note the latest version number of the software-upgrade package(s).

Web site software version number	

4. If the latest software version at the Web site is the same as the version installed on your instrument, you do not need to upgrade the instrument software.

5. If the latest software version at the Web site is newer than the version on your instrument, download the latest version to your computer.

6. After the software package ZIP file is downloaded, extract the following files into the directory of your choice: transfer.exe and firmware.pkg.

NOTE. *If a readme.txt file is included in the software package, be sure to read the file before you upgrade the software.*

7. If the software in your instrument needs to be upgraded, verify which options are currently installed before you install the software. After you install the upgrade, you will verify that the new options are installed and that any previously installed options are still enabled.

a. Connect the instrument and computer to your local Ethernet network. (See page 16, *Configure the network interface*.)

b. Power on the instrument.

c. On the computer, open a Web browser.

d. In the URL address box, enter the IP address assigned to the instrument you are upgrading. For example, http://192.168.1.1. This opens the Tektronix WFM Remote Interface home page.

e. Click **Instrument Options**.

f. Make a note of the enabled options or print out the Active Options page.

Software upgrade overview

There are two methods for upgrading the instrument software:

- Using a USB memory device (See page 137, *USB software installation*.)

- Using an Ethernet network (See page 139, *Network software installation*.)

The time required to complete the software upgrade is approximately 10 minutes.

⚠️ **CAUTION.** *Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 142, Software installation troubleshooting.)*

NOTE. To help ensure an uninterrupted upgrade process, fully charge the battery pack and connect the instrument to the AC adapter before you begin the upgrade.

If power to the instrument is lost before it begins erasing the internal flash, you can restart the software upgrade after the instrument reboots. If the instrument displays only a blank screen after power is reapplied, see the troubleshooting section for help. (See page 142, Software installation troubleshooting.)

Software upgrade from version 1.0.4

When you upgrade an instrument that has software version 1.0.4 installed, you must perform the software upgrade process twice to completely load the new firmware package into the flash memory of the instrument.

During the first installation, the following error message will be displayed after the LCD driver upgrade is initialized:

`ERROR: R-1d-U21 Update failure.`

When this message is displayed, you need to reboot the instrument and restart the upgrade process as instructed in the following procedures. The second software installation attempt will finish programming the remaining LCD Driver and splash image into the flash memory.

USB software installation

Use the following steps to upgrade the instrument software using a USB memory device.

1. Insert a USB memory device into a USB port of the computer containing the latest instrument software.

2. On the computer, navigate to the USB device.

3. On the USB device, create a directory named **WfmUpgrd**.

⚠️ **CAUTION.** *To prevent upgrade failure, be sure to correctly name the upgrade directory. The directory name is case sensitive, with the "W" and the "U" in WfmUpgrd being upper case.*

4. Open the WfmUpgrd directory and copy the firmware.pkg file from the downloaded ZIP file to the USB device. The USB device should have a directory path of **WfmUpgrd\firmware.pkg**.

5. Eject and safely remove the USB device from the computer.

6. Power on the instrument and wait for the instrument to fully boot up before inserting the USB device into the USB port on the top panel of the instrument .

7. Press the **CONFIG** front panel button.

8. Navigate to **Utilities** > **System Upgrade** > **Upgrade Options** > **USB Upgrade**.

NOTE. If the instrument displays a message indicating that a USB device containing firmware was not detected, make sure you have the correct directory path on the USB device. Also, press the MAIN front panel button to verify that the USB device is properly mounted.

If the instrument still does not recognize the USB device, attempt the procedure again using a different USB device from a well known brand that is 16 GB or less.

9. Press the **SEL** front panel button. This displays the System Software Upgrade from USB window.

10. Select **Continue** from the System Software Upgrade from USB window and press **SEL** to start the software upgrade. During the upgrade process, the instrument displays messages indicating the upgrade status.

⚠ **CAUTION.** *Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 142, Software installation troubleshooting.)*

When you upgrade an instrument that has software version 1.0.4 installed, you must perform the software upgrade process twice as instructed below to completely load the new firmware package into the flash memory of the instrument.

11. If you are upgrading from software version 1.0.4, the following error message appears on the instrument display after the LCD driver upgrade is initialized:

```
Updating LCD Driver...
R-1d-U21 Update failure

**************************************************
* System Software Upgrade FAILED.                *
* Error during Flash Programming.                *
* DO NOT POWER CYCLE the instrument.  Verify the data   *
* on the USB storage device and restart the upgrade!  *
**************************************************
```

When this error message is displayed, press and hold the Power button for 5 seconds and then release to power off the instrument. Press the Power button again to power on the instrument.

NOTE. *If you are upgrading an instrument that has a later software version than 1.0.4 installed, then the upgrade should complete on the first attempt without any error messages.*

12. If you are upgrading from software version 1.0.4, perform this procedure a second time starting at step 6.

13. If the instrument does not reboot at the completion of the software upgrade, press and hold the Power button for 5 seconds to turn off the instrument. Press the Power button again to turn on the instrument.

14. Remove the USB device after the upgrade is complete:

⚠️ **CAUTION.** *To prevent a loss of data on the USB device, use the MAIN menu to unmount the USB device before removing it from the instrument.*

    a. Press the **MAIN** front panel button.

    b. Navigate to **USB Unmount**, and then press the **SEL** button.

    c. Remove the USB device after the USB Unmount selection disappears from the MAIN menu.

Network software installation

Use the following steps to upgrade the instrument software using a network connection:

1. Connect the instrument and a Windows PC to your local Ethernet network or directly connect the instrument to a Windows PC. (See page 16, *Configure the network interface.*)

2. Power on the instrument.

3. Prepare the instrument for the software upgrade:

    a. Press the **CONFIG** front panel button.

    b. Navigate to **Utilities** > **System Upgrade** > **Upgrade Options** > **Network Upgrade**.

    c. Press the **SEL** front panel button. Note the IP address of the instrument displayed in the System Software Upgrade window.

    d. Select **Continue** from the System Software Upgrade window, and then press the **SEL** button to prepare the instrument to receive a software upgrade.

4. Perform the software upgrade:

   a. On the PC, double-click the **transfer.exe** file to launch the transfer program.

   b. Type the IP address or DNS name of the instrument you are upgrading, and then press **Enter**. This starts the software upgrade process.

   ⚠ *CAUTION. Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 142, Software installation troubleshooting.)*

   NOTE. The upgrade will not proceed until all of the software data is transferred to the instrument. Once the upgrade has started, the instrument will attempt to complete the upgrade even if it loses contact with transfer.exe. So that you can monitor the progress of the upgrade, it is suggested that you do not close the transfer.exe window until the transfer utility asks for another IP address.

   When you upgrade an instrument that has software version 1.0.4 installed, you must perform the software upgrade process twice as instructed below to completely load the new firmware package into the flash memory of the instrument.

   c. If you are upgrading from software version 1.0.4, the following error message appears during the upgrade after the LCD driver upgrade is initialized:

   – **Transfer utility window:** (See Figure 44.)

   ```
   Initializing LCD Driver Upgrade...  done
   ERROR: R-1d-U21 Update failure.
   Please enter DNS name or address of target
   instrument:
   ```

   – **Instrument display:**

   ```
   Updating LCD Driver...
   R-1d-U21 Update failure
   Waiting for TCP connection at XXX.XXX.XXX.XXX
   ```

When this error message is displayed, press and hold the Power button for 5 seconds and then release to power off the instrument. Press the Power button again to power on the instrument.

NOTE. If you are upgrading an instrument that has a later software version than 1.0.4 installed, then the upgrade should complete on the first attempt without any error messages.

   d. After the instrument reboots, if you configured the network settings of the instrument for DHCP when you started this upgrade, navigate to CONFIG > Network Settings > IP Config Mode and select **DHCP**.

   e. If you are upgrading from software version 1.0.4, perform this procedure a second time starting at step 3.

   f. After the second upgrade process completes, the transfer utility displays **done**. The instrument then reboots after a few seconds.

Figure 44: Sample of transfer.exe window after the upgrade is complete

5. If the instrument does not reboot at the completion of the software upgrade, press and hold the Power button for 5 seconds to turn off the instrument. Press the Power button again to turn on the instrument.

Verify the software and installed options

1. If the instrument did not reboot at the completion of the software upgrade, cycle the power to the instrument to cause it to reboot.

2. Press the **CONFIG** button on the front panel.

3. Navigate to **Utilities** > **View HW/SW Version**.

4. Verify that the software version number matches the version of the software-upgrade package you installed.

5. Navigate to **Utilities** > **View Options**.

6. Verify that the options that were enabled to the software upgrade are still enabled.

Software installation troubleshooting

If a power failure occurs during SW upgrade and the instrument has a blank screen when you reapply power, perform the following procedure.

1. Connect an Ethernet cable directly from your computer to the instrument. You must use a direct network connection.

2. Press and hold the Power button for 5 seconds to turn off the instrument.

3. Press and hold the ◄ (left arrow) key while you press the Power button.

4. The instrument will turn on and the default IP address of 192.168.1.1 will be set.

5. Set the IP address of your computer to 192.168.1.x, where x ≠ 0, 1, or 255.

6. Enter the IP address of the instrument (192.168.1.1) for the upgrade transfer application.

7. Start the upgrade process. When it is complete, the instrument should reboot. If it does not, cycle the power.

⚠ *CAUTION. To prevent upgrade failure, leave the instrument power on during the upgrade process. The upgrade process may take up to 15 minutes to complete.*

If you continue to experience an upgrade problem, contact Tektronix customer support or your local Tektronix representative for assistance.

Checking chroma/luma delay

The Lightning display can be used for interchannel timing measurements. If the color-difference signal is not coincident with luma, the transitions between the color dots will deviate from the center mark of a delay scale. The amount deviated represents the relative signal delay between luma and the color-difference signal.

Perform the following steps to check chroma/luma delay using the Lightning display:

1. Connect a color bar signal to the SDI A or SDI B input and then press the associated INPUT A or INPUT B button to select that video input to monitor.

2. Press and hold the **VECTOR** button to open the Vector pop-up menu.

3. In the Vector pop-up menu, set the **Display Type** to **Lightning**.

4. Set **Bar Targets** to match your input signal.

5. Select **Center Waveform** and press the **SEL** button to center the waveform.

6. Press the **VECTOR** button to close the pop-up menu.

7. Determine where transitions intersect the delay scales and derive the timing error in nanoseconds, as deflected from the center mark, using the following guidelines. (See Figure 45.)

   - The center mark of the nine marks spanning each green-magenta transition is the zero error point.

   - Alignment to a mark toward black means the color-difference signal lags with respect to luma.

   - Alignment to a mark toward white means the color-difference signal leads the luma signal.

   - The upper half of the display measures the Pb to Y timing; the bottom half measures the Pr to Y timing.

Green-to-Magenta transitions   Delay scale
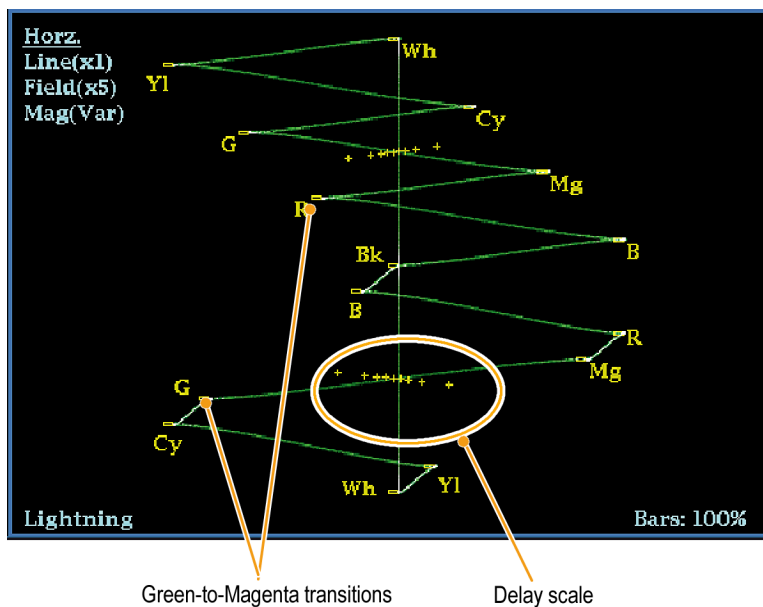
Figure 45: Determining transition intersections in the Lightning display

The + tic marks on the Lightning graticule indicate the timing errors shown in the following table:

Tic mark	SD Timing error (ns)	HD Timing error (ns)	1080p 50, 59.94, 60, 3Gbps (3 Gb/s and dual link formats) Timing error (ns)
0 marks	0	0	0
1st	20	2	1
2nd	40	5	2.5
3rd	74 [1]	13.5	6.75
4th	148 [2]	27	13.5

[1]   Luma sample

[2]   Chroma sample

Checking gamut

Signals that are legal and valid in one signal representation may not be legal in another representation. Specifically, signals which are legal in the Digital YCbCr representation may not be legal if transcoded to RGB or encoded to NTSC / PAL. Any signal that fails this test is considered out of gamut.

You can set custom gamut thresholds using the CONFIG > Gamut Thresholds submenu or you can reset the gamut thresholds to default values.

Your instrument supports multiple displays and alarms to detect out-of-gamut signals. The flexible, tiled display allows you to simultaneously view several gamut measurements to learn which is most appropriate for a given application. The displays are and their uses follow:

- **Diamond display:** Checks that SDI signals conform to legal RGB gamut space.

- **Split Diamond display:** Separates the upper and lower diamonds to show excursions below black; otherwise it is identical to the Diamond display.

- **Arrowhead display:** Checks if an SDI signal is legal for composite color space.

The Diamond, Split Diamond, and Arrowhead displays have adjustable thresholds. If the signal goes outside the area defined by the thresholds, the signal is out of gamut. If these limits are exceeded, then the instrument can generate alarms if configured to do so.

For composite waveforms, the legal limit is simply the maximum level allowed for the combination of luma and chroma. This limit depends on the application. For example, a video tape machine may be able to record and play out signals with higher luma and chroma components than a transmitter.

To set up gamut checks

1. Connect a video signal to an SDI input on the rear panel.

2. Select a tile in which to view the Gamut Display and press and hold the **GAMUT** button.

3. In the Gamut pop-up menu, select from the following gamut display types:

    - Diamond – Use to detect, isolate, and correct RGB component gamut errors. (See page 146, *Checking RGB gamut*.)

    - Split Diamond – Use to reveal hard-to-find black gamut errors.

    - Arrowhead – Use to detect composite gamut errors, without employing a composite encoder.

4. Press the **GAMUT** button to dismiss the pop-up menu.

5. Press the **CONFIG** button and select **Gamut Thresholds**.

6. Set the thresholds as desired.

Checking RGB gamut

The Diamond display effectively shows how the R, G, and B signals relate and is a good tool for detecting gamut errors.

To form the Diamond display, the instrument converts the Y, P_b, and P_r components recovered from the serial signal to R, G, and B. To predictably display all three components, they must lie between peak white, 700 mV, and black, 0 V.

For a signal to be in gamut, all signal vectors must lie within the G-B and G-R diamonds. Conversely, if a signal vector extends outside the diamond, it is out of gamut. The direction of an excursion out of gamut indicates which signal is excessive. Errors in green amplitude affect both diamonds equally, while blue amplitude errors affect only the top diamond and red errors affect only the bottom diamond. (See Figure 46.)
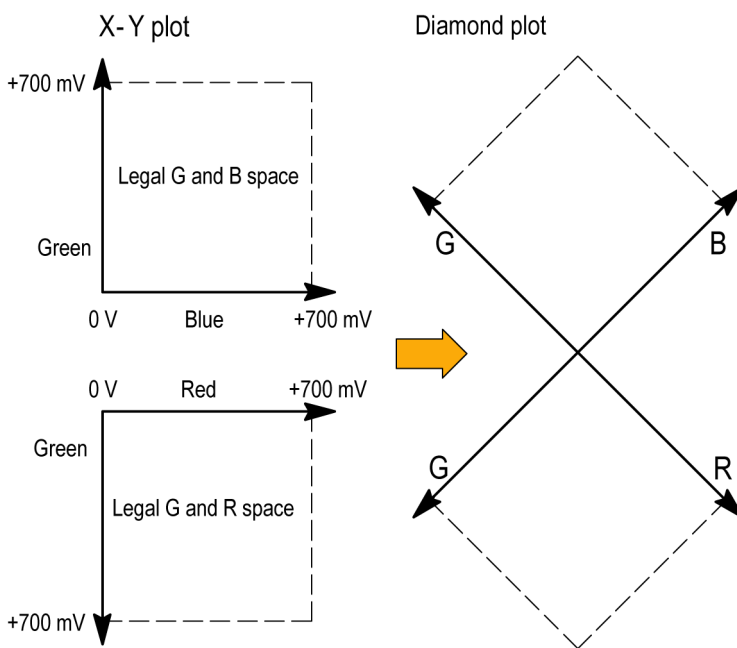
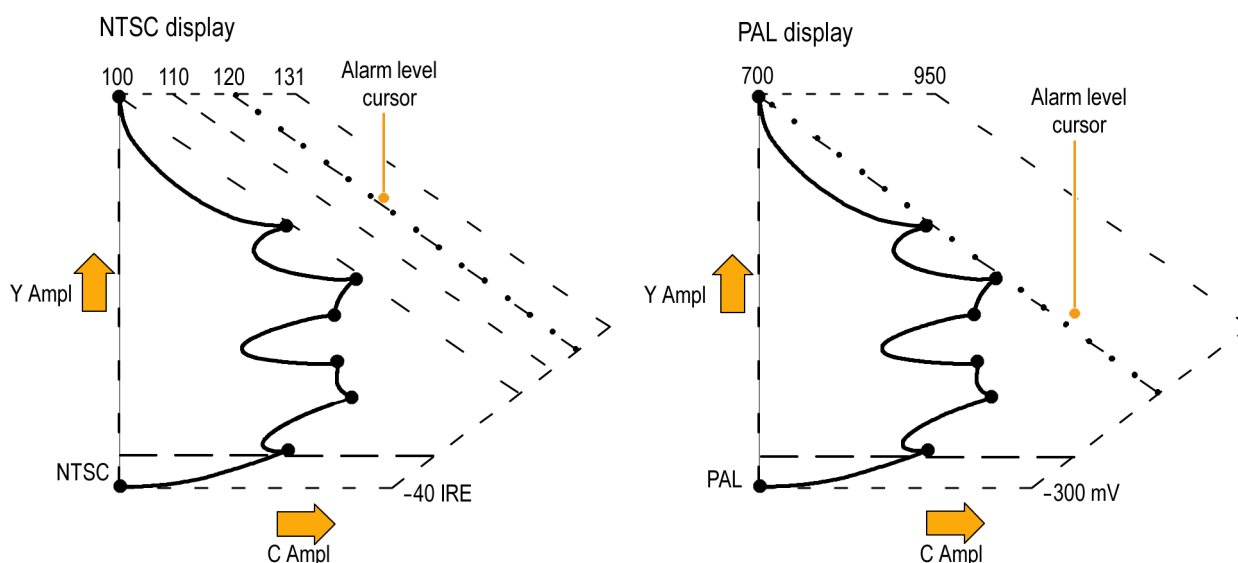**Figure 46: Diamond display plot**

Set the thresholds for gamut. (See page 145, *To set up gamut checks*.) After selecting the **Diamond** display, compare the signal to the display to determine out-of-gamut components. Note the following:

- The intensity of a vector indicates its duration.

- A momentary out-of-gamut condition appears as a faint trace. Long duration violations show as a bright trace.

When evaluating out-of-gamut components, consider the following examples. (See Figure 47.)

- Example A:
  R - Ok
  G > 700 mV
  B - Ok

- Example B:
  R - Ok
  G - Ok
  B > 700 mV

- Example C:
  R - Ok
  G - Ok, 350 mV
  B < 0 mV
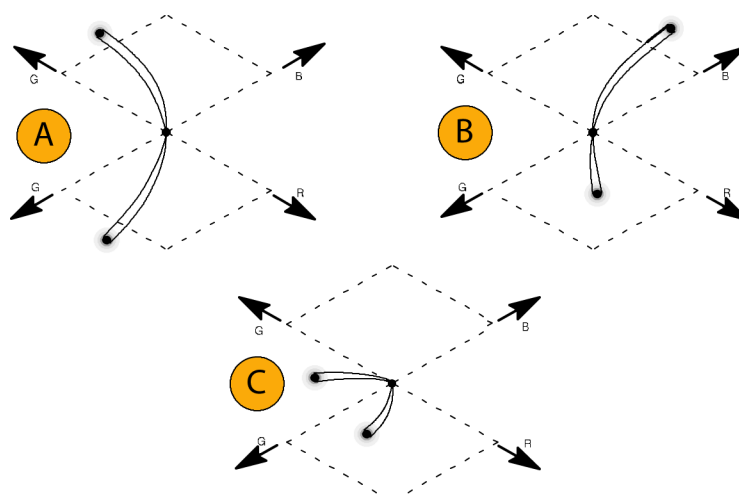
Figure 47: Out-of-gamut examples

Usage notes   As with the Lightning display, bending of the transitions indicates timing delays. When a color bar signal is applied, the vertical axis becomes an indicator of delay errors.

On the Diamond display, monochrome signals appear as vertical lines. Nonlinear component processing, such as from a gamma corrector that alters white balance, can cause deviations along the vertical axis.

To isolate gamut bright-ups, try the following:

- Use the **LINE SEL** button to select individual lines.

- Use the **PICT** display to examine the signal (turn on gamut bright-ups in the Display Settings submenu of the Configuration menu).

- Use the **Diamond Area** or **Arrowhead Area** settings (found in the Gamut Thresholds submenu of the Configuration menu) to specify a percentage of the image pixels to ignore for gamut violations. The Gamut bright-ups, however, will continue to indicate all Gamut violations.

Checking composite gamut

The Arrowhead gamut display plots luminance (Y) against chrominance (C) to check if the composite signal adheres to standard gamut. NTSC and PAL Arrowhead displays (75% Color bars) and indicates the values of the graticule lines. The arrowhead shape of the graticule results from overlaying the standard limits for luminance and luminance-plus-peak chrominance. (See Figure 48.)

Figure 48: Arrorwhead gamut display plots

Set the thresholds for gamut. (See page 145, *To set up gamut checks*.) After selecting the **Arrowhead** display, compare the signal to the display to determine out-of-gamut composite components. Note the following:

- Signals exceeding the luminance amplitude gamut extend above the top horizontal limit (top electronic graticule line).

- Signals exceeding the luminance plus peak chrominance amplitude gamut extend beyond the upper and lower diagonal limits.

- The bottom horizontal line shows the minimum allowed luminance level. 0 or 7.5 IRE for NTSC and 0 mV for PAL.

Usage notes   To automate this check, do the procedure *Automating Gamut Checks*. (See page 150.)

Checking luma gamut

Luma limit thresholds can be configured for identifying luma exceeding threshold limits. They apply to both the incoming SDI and to the Arrowhead representation of the SDI input as a composite signal. By defining these levels in percent, they automatically account for the presence or absence of setup. The thresholds are affected by your choice of set-up or no set-up for the Arrowhead display.

Set the thresholds for gamut. (See page 145, *To set up gamut checks*.) After selecting the **Arrowhead** display, compare the signal to the display to determine out-of-gamut luminance. Note the following:

- The adjustable thresholds are indicated by the dark blue horizontal graticule lines.

- The thresholds are defined in terms of percent of full scale.

- The range for the Upper limit is 90% to 108%.

- The range to the Lower Limit is –6% to +5%.

Another useful Arrowhead function is a measure of how well the active video signal is using the dynamic range of the video channel. A properly adjusted signal should be centered in the arrowhead graticule and have transitions that approach all the limits.

Automating gamut checks

You can use alarms to automatically monitor for out-of-gamut conditions.

1. Check that Gamut thresholds are configured as you want them. (See page 145, *To set up gamut checks*.)

2. Press the **CONFIG** button to display the Configuration menu.

3. Select **Alarms** and then **Video Content**. A dialog box appears where you can select for the various Video Content alarms.

4. Use the up/down arrow keys to move to each of the alarms that you want to set. Press the **SEL** button to toggle the alarm on (X) or off.

5. When you have configured the Alarms as you want them, move to the **Select here** box and select it.

6. Back in the Alarms menu, check that **Enable Alarms** is set to **On** before exiting the Alarms menu.

ARIB content displays

Your instrument supports conformance to ARIB data standards contained in the signal source. The ARIB content in the signal is shown in the following status displays:

■ ARIB Status

■ ARIB STD-B.39 Display

■ ARIB STD-B.37 Display

■ ARIB STD-B.35 Display

■ ARIB TR-B.23 (1) Display

■ ARIB TR-B.23 (2) Display

■ ARIB TR-B.22 Display

The following DID and SDID values are defined for common types of ARIB-compliant data.

DID and SDID values for common ARIB data types

Ancillary data type	DID value	SDID value
ARIB TR-B.22, Sub Information of transmitting materials	0x5F	0xE0
ARIB TR-B.23, Line 20 User Data - 1	0x5F	0xFC
ARIB TR-B.23, Line 20 User Data - 2	0x5F	0xFB
ARIB STD-B.35 Trigger Signal for Data Broadcasting	0x5F	0xFD
ARIB STD-B.37 Closed Captioning		
Analog signal	0x5F	0xDD
SD signal	0x5F	0xDE
HD signal	0x5F	0xDF
ARIB STD-B.39 Inter Stationary Control Data		
ARIB specification	0x5F	0xFE
ITU specification	0x43	0x01

To enable the ARIB content displays

Before you can view the ARIB content displays, you must enable the ARIB displays using the CONFIG > Aux Data Settings > ARIB Content Display submenu.

ARIB Status display

The ARIB Status display is a status summary screen for the signal. (See Figure 49.)
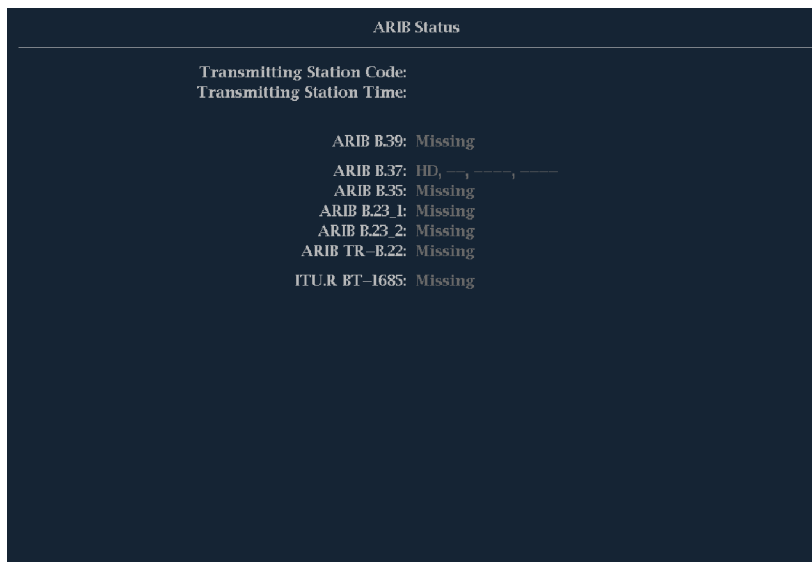
Figure 49: ARIB Status display, showing no ARIB data present

Use the ARIB Status display with the other specific ARIB Display screens to quickly determine if the data you are interested in is present in the signal. If the data is present, use the STATUS > ARIB Display menu to select the specific ARIB data packet type to view.

The ARIB Status display shows the presence (or absence) of each of the following supported standards (STD), technical reports (TR), or ITU standard:

- Transmitting station code (unique identification code of the transmitting station).

- Transmitting station time (time of broadcast from the transmitting station).

- ARIB STD-B.39 (inter-stationary control data).

- ARIB STD-B.37 (closed caption data).

- ARIB STD-B.35 (trigger signal data).

- ARIB TR-B.23 (1) (guidelines for inter-stationary control data transport, group 1).

- ARIB TR-B.23 (2) (guidelines for inter-stationary control data transport, group 2).

- ARIB TR-B.22 (guidelines for ancillary data transport).

- ITU.R BT-1685 (inter-stationary Control Data conveyed by ancillary data packets).

ARIB STD-B.39 display

The ARIB STD-B.39 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.39. (See Figure 50.) When this display is selected, the instrument searches the signal for ARIB STD-B.39 packets using the DID/SDID combinations defined by either the ITU or ARIB standards organizations.

Figure 50: ARIB STD-B.39 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested inter-stationary control packet; can be any of the following:
  - ARIB specification - 0x5F
  - ITU Specification - 0x43

- Type - Type of the ANC Data packet. For ARIB B.39, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.

- SDID - Secondary Data Identifier of the requested interstationary control packet; can be any of the following:

    - ARIB specification - 0xFE

    - ITU Specification - 0x01

- Line - The line of the video (within the field) from which the packet was acquired.

- Stream - For HD (SMPTE 292M, SMPTE 372, SMPTE 425), indicates whether the ancillary packet was acquired from the Y or C data streams. For SD, N/A is displayed.

- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

- Checksum - Indicates the checksum word that was recovered from the acquired packet.

- Should be - Indicates the checksum word computed by the instrument, based on the packet data.

- Format - Indicates the name of the ancillary data type or standard.

- Inter-Station Ctrl Header - A header byte indicating packet continuity, and the presence or absence of the error correcting code.

- Transmitting Station Code - The name of the transmitting station. The instrument supports the display of Japanese characters.

- Transmitting Station Time - The broadcast time at the transmitting station.

- Current Video Mode - The video format of the current program.

- Next Video Mode - The video format of the next scheduled programming.

- Video Mode Countdown - A countdown timer indicating an upcoming change in video mode, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.

- Current Downmix/Audio Mode - Indicates the audio downmix and soundstage configuration of the current program.

- Next Downmix/Audio Mode - Indicates the audio downmix and soundstage configuration of the next scheduled program.

- Audio Mode Countdown - A countdown timer indicating an upcoming change in audio mode, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.

- Trigger Bits (Q8..Q1 Q16..Q9) - Together with trigger bits Q24..Q17 Q32..Q25, 32 bits that can be used to indicate changes in the program; usage is user-defined.

- Trigger Bits (Q24..Q17 Q32..Q25) - Together with trigger bits Q8..Q1 Q16..Q9; 32 bits that can be used to indicate changes in the program; usage is user-defined.

- Trigger Counter - Increments when bits Q1-Q4 go from 0 to 1. Wraps from 254 (0xFE) to zero. Value of 0xFF indicates the trigger counter is not used.

- Trigger Countdown - A countdown timer indicating an upcoming change in trigger bits Q1-Q4, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.

- Status Bits (S8..S1 S16..S9) - 16 user-defined status bits.

- Error Correcting Code - A six-word, Reed-Solomon error correcting code, which is used to verify the integrity of the ARIB B.39 or ITU-R BT.1685 packet.

ARIB STD-B.37 display and status screens

The ARIB STD-B.37 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.37. (See Figure 51.) When this display is selected, the instrument searches the signal for ARIB STD-B.37 packets using the DID/SDID combinations defined by ARIB.

Figure 51: ARIB STD-B.37 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested closed captioning packet; can be any of the following:

  - Analog signal - 0x5F

  - SD Signal - 0x5

  - HD Signal - 0x5F

- SDID - Secondary Data Identifier of the requested packet; can be any of the following:

  - Analog signal - 0xDD

  - SD Signal - 0xDE

  - HD Signal - 0xDF

  - Mobile signal - 0xDC

- Field/Line - The field or line of the video from which the packet was acquired. Displays 1 for progressive formats.

NOTE. The Line field turns red if the ARIB B.37 packets are not on the line as defined by ARIB TR-B.23.

- Format - Indicates the name of the ancillary data type or standard.

- Header 1st - Displays the first of four User Data Words of the corresponding packet, in binary.

- Header 2nd - Displays the second of four User Data Words of the corresponding packet, in binary.

- Header 3rd - Displays the third of four User Data Words of the corresponding packet, in binary.

- Header 4th - Displays the last of four User Data Words of the corresponding packet, in binary.

- ECC Status - Indicates the presence or absence of the Error Correcting Code information in the payload.

- Format ID - Indicates whether the packet is for HD, SD, Analog, or Mobile captions.

- Language - Indicates the language code (1st through 8th) of the packet.

■ CC Data ID - Indicates the CC Data ID of the packet. Can be one of the following:

  - Exchange Format CC

  - Exchange Format PMI

  - Exchange Format Page 1

  - Exchange Format Page 2

  - Short Form Management Data

  - Short Form Text

  - Undefined or Dummy Data

■ Set Mode - Mode can be either Sequential or Buffer.

■ Packet Flags - Indicates whether the packet is Leading, End, Intermediate, or Single.

■ Checksum - Indicates the checksum word that was recovered from the acquired packet.

■ Placement - Can display either OK or ERROR, indicating whether the ARIB B.37 packets are present in the allowable configuration(s) specified in ARIB TR-B.23.

ARIB STD-B.35 display and status screens

The ARIB STD-B.35 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.35. (See Figure 52.) When this display is selected, the instrument searches the signal for ARIB STD-B.35 packets using the DID/SDID combinations defined by ARIB.

Figure 52: ARIB STD-B.35 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.

- Type - Type of the ANC Data packet. For ARIB B.35, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.

- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.

- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.

- Line - The line of the video (within the field) from which the packet was acquired.

- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.

- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

- Checksum - Indicates the checksum word that was recovered from the acquired packet.

- Should be - Indicates the checksum word computed by the instrument, based on the packet data.

- Format - Indicates the name of the ancillary data type or standard.

- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.23 (1) display and status screens

The ARIB TR-B.23 (1) display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.23 (1). (See Figure 53.) When this display is selected, the instrument searches the signal for ARIB TR-B.23 (1) packets using the DID/SDID combinations defined by ARIB.

Figure 53: ARIB TR-B.23 (1) display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

■ DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.

■ Type - Type of the ANC Data packet. For ARIB TR-B.23-1, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.

■ SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

■ DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.

■ Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.

■ Line - The line of the video (within the field) from which the packet was acquired.

■ Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.

■ Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

■ Checksum - Indicates the checksum word that was recovered from the acquired packet.

■ Should be - Indicates the checksum work computed by the instrument, based on the packet data.

■ Format - Indicates the name of the ancillary data type or standard.

■ User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.23 (2) display and status screens

The ARIB TR-B.23 (2) display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.23 (2). (See Figure 54.) When this display is selected, the instrument searches the signal for ARIB TR-B.23 (2) packets using the DID/SDID combinations defined by ARIB.

Figure 54: ARIB TR-B.23 (2) display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.

- Type - Type of the ANC Data packet. For ARIB TR-B.23-2, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.

- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.

- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.

- Line - The line of the video (within the field) from which the packet was acquired.

- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.

- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

- Checksum - Indicates the checksum word that was recovered from the acquired packet.

- Should be - Indicates the checksum work computed by the instrument, based on the packet data.

- Format - Indicates the name of the ancillary data type or standard.

- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.22 display and status screens

The ARIB TR-B.22 display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.22. (See Figure 55.) When this display is selected, the instrument searches the signal for ARIB TR-B.22 packets using the DID/SDID combinations defined by ARIB.

Figure 55: ARIB TR-B.22 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.

- Type - Type of the ANC Data packet. For ARIB TR-B.22, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.

- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.

- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.

- Line - The line of the video (within the field) from which the packet was acquired.

- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.

- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.

- Checksum - Indicates the checksum word that was recovered from the acquired packet.

- Should be - Indicates the checksum work computed by the instrument, based on the packet data.

- Format - Indicates the name of the ancillary data type or standard.

- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

Audio monitoring

Your instrument can monitor embedded audio signals, measure levels, monitor phase, display phase correlation, and monitor surround-sound audio. You can specify meter ballistics and scales, set test and peak program indicator levels, and specify how phase is displayed.

To configure embedded audio inputs and alarms

Audio inputs come set to factory defaults. As a result, you may need to configure them before performing the audio monitoring procedures in this section. Your setup here determines, in part, which audio-signal characteristics are displayed.

Perform the following steps to configure the embedded audio inputs:

1. Press the **CONFIG** button to display the configuration menu.

2. Select **Audio Inputs/Outputs**, and then select the input to be configured: Embedded A, Embedded B, or Embedded Dual Link.

3. Select **Bar Format**, and then select one of the following formats:

   - **Raw Pairs** for a *stereo with SAP and discrete channels* type installation.

   - **Program (Surround)** for a surround sound type installation.

4. If you selected the Program (Surround) bar format, select **Program Cfg** and then select the type of surround sound installation.

5. If you selected the Program (Surround) bar format, select **Surround Mapping** and then set the mapping type to **SMPTE 320** or **UK**.

6. Set the bar to input mapping as follows:, and then

   a. Select **Bar to Input Map**.

   b. Select which input pair should be displayed in each bar pair.

   c. Select which inputs are allowed to generate alarms.

   d. Select the **Return** box to return to the Configuration menu.

7. Repeat these steps for any other Audio inputs that you want to configure.

To display an audio input

You select the audio input to be monitored from the front-panel **AUDIO** button pop-up menu. Note that the Audio display can appear in only one tile at a time.

1. If you are in Quad Tile mode, select the tile in which you want to monitor an audio signal.

2. Press and hold the **AUDIO** button to select the Audio display and open the Audio pop-up menu.

3. Select **Audio Input**, and then select the desired audio input. (See page 53, *Audio input*.)

To check audio level and phase

Level meters are vertical bar graphs on which the height of the bar indicates the amplitude of the audio program in the corresponding input channel. Use the Audio pop-up menu to change the input and turn on and off the Phase display. Other meter characteristics such as ballistics, scale units, and program and test levels are configured through the Configuration menu.

If your instrument is equipped with optional audio features, it can display phase of one input pair as a Lissajous pattern, and display relative phase on all four pairs of inputs with correlation meters.

To check audio level

1. Open the audio display in one tile and select an input. (See page 168, *To display an audio input*.)

2. Configure the input for your installation. (See page 167, *To configure embedded audio inputs and alarms*.)

3. Check the level meter bars for current audio levels, which are displayed according to the selected meter ballistics. Each bar displays three colors. (See Figure 56.)

    ⁻ Green – Indicates audio levels below the test level.

    ⁻ Yellow – Indicates audio levels between the test and peak program level.

    ⁻ Red – Indicates audio levels above the peak program level.
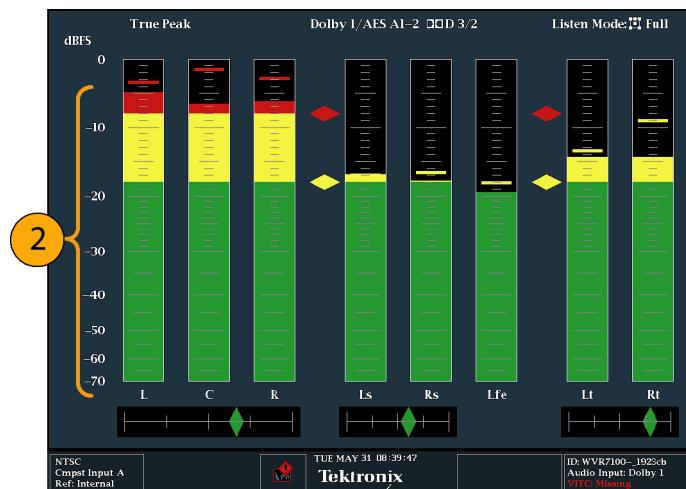
Figure 56: Audio levels

To check audio phase

1. Select **Aux Display**.

2. Select **Phase Display** to turn it on.

3. Select the **Phase Style**. Choose either a **Lissajous Soundstage** or **X-Y** orientation for the Lissajous signal.

4. Select the phase pair to be displayed, or select **Custom** and select independent channels using the Phase Channel A and Phase Channel B entries.

5. Set the Audio Input to match the signal that you are checking (or use the Audio Follows Video mode set in the CONFIG menu).

6. Check for Phase correlation of the signals, noting the following: (See Figure 57.)

   - Phase correlation meters are located under the appropriate bars and one is duplicated under the phase display.

   - For identical and correlated signals, the indicator is white and moves to the right side.

   - For highly correlated signals, the indicator is green and moves to the right side.

   - For uncorrelated signals, the indicator is yellow and tends to stay in the middle.

   - For anticorrelated signals (one goes up when the other goes down), the indicator is red and moves to the left side.
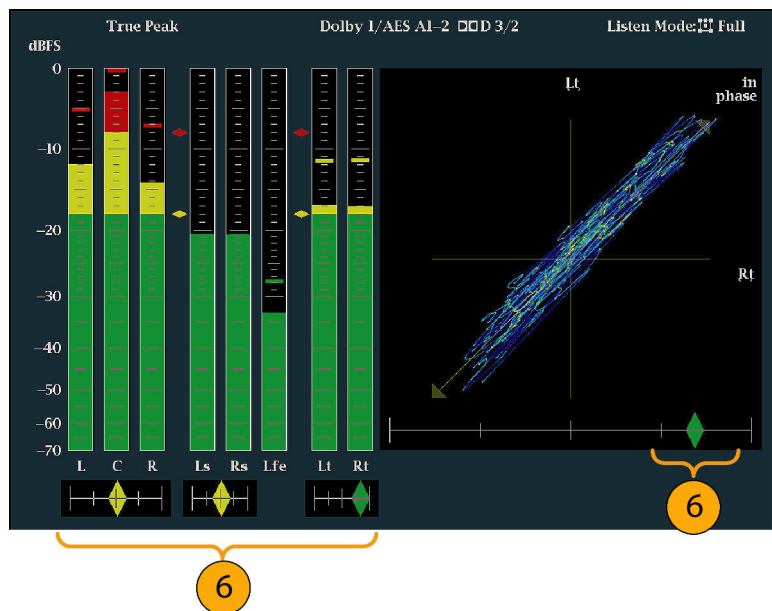
Figure 57: Checking for phase correlation

Usage notes
- The Lissajous or phase display is a plot of one channel against another on an orthogonal pair of axes.

- Soundstage plots the two channels at 45 degree angles, with the mono combination appearing on the vertical axis– like a left-right image in a studio.

- X-Y plots left-channel data on the vertical axis and right channel data on the horizontal axis, emulating the X-Y display of an oscilloscope.

- The following response times of the correlation meters can be set from the Configuration menu.

Speed setting	Response averaging time (s)	Speed setting	Response averaging time (s)
1	0.0167	11	3.0
2	0.0333	12	3.5
3	0.0667	13	4.0
4	0.1333	14	4.5
5	0.2667	15	5.0
6	0.5333	16	5.5
7	1.0	17	6.0
8 (default)	1.5	18	6.5
9	2.0	19	7.0
10	2.5	20	7.5

To monitor embedded 16-channel audio

To configure audio inputs for embedded 16-channel audio

To set up an Audio Input for embedded 16-channel audio:

1. Press the **CONFIG** button to open the Configuration menu.

2. Select **Audio Inputs/Outputs > Video to Audio Map**.

3. Select **SDI Input 1A** or **SDI Input 1B**.

4. Select **Emb. 16-Ch**.

5. To set the appropriate ballistics for the level meter display, use the **Digital Audio Displays > Ballistics** selections to set the ballistics to **True Peak**, **PPM Type 1**, or **PPM Type 2**.

6. Press and hold the **AUDIO** button to open the Audio pop-up menu.

7. Use the arrow keys to select **Audio Input** and then select **Follows Video**.

8. Press the **AUDIO** button to close the pop-up menu.

Functions not supported for 16-channel audio. The following functions are not supported for 16-channel audio:

- Audio input to bar mapping

- Audio output mapping

- Correlation meters

- Lissajous and phase displays

- Headphone

NOTE. You cannot modify the input and output mapping because the mappings are fixed for 16-Channel audio.

To set the audio input for embedded 16-channel audio

1. Press and hold the **AUDIO** button to open the Audio display and view the Audio pop-up menu.

2. Select **Audio Input** and then select the **Emb. 16-Ch** option.

3. Press the **AUDIO** button to close the pop-up menu. The following figure shows the 16-channel audio bars display.
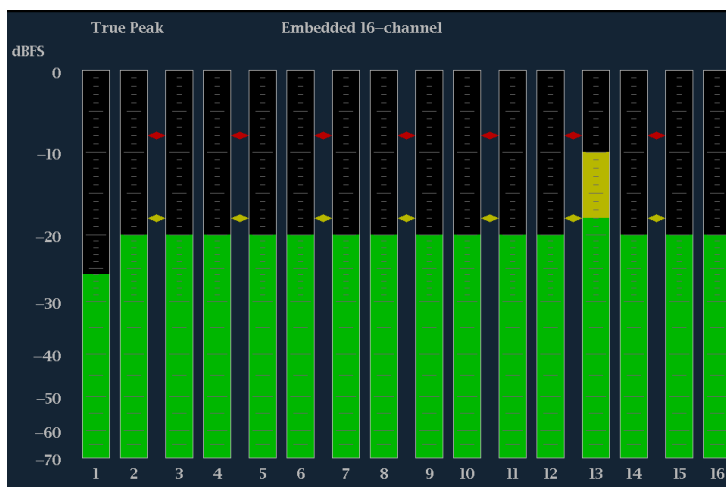
Figure 58: 16-Channel audio bars display

To quickly select channels 1-8 or 9-16 of the embedded audio

1. Press and hold the **AUDIO** button to open the Audio display and view the Audio pop-up menu.

2. Select **Audio Input** and then select **Emb. 1-8** or **Emb. 9-16**.

3. Press the **AUDIO** button to close the pop-up menu.

NOTE. When the audio input source is set to Emb. 16-Ch, Emb. 1-8, or Emb. 9-16, you can then use the left/right arrow keys to quickly toggle through these three audio input sources.

To check surround sound

Your instrument can also display the surround sound listening environment. The following procedures help you get started.

1. Open the audio display in one tile and select the input containing the surround audio. (See page 168, *To display an audio input*.)

2. Configure the input for your installation. (See page 167, *To configure embedded audio inputs and alarms*.)

3. Select **Aux Display** and then select **Surround Sound Display**. Press **SEL** or the right-arrow key to turn the phase display on.

4. Set the Audio Input to match the signal that you are checking.

*NOTE. If you want the level bars labeled with their surround sound channel names instead of channel numbers, select **Srnd** (Surround) when you configure the audio inputs. (See page 167, To configure embedded audio inputs and alarms.)*

5. Set the surround **Dominance indicator** to **ON** or **OFF**.

6. Use the level bar display to monitor level control. (See page 168, *To check audio level*.)

7. Use the surround display to monitor relative loudness of the individual elements rendered in a surround-sound listening environment. Check the surround sound display for performance parameters and indicators. (See Figure 59.)
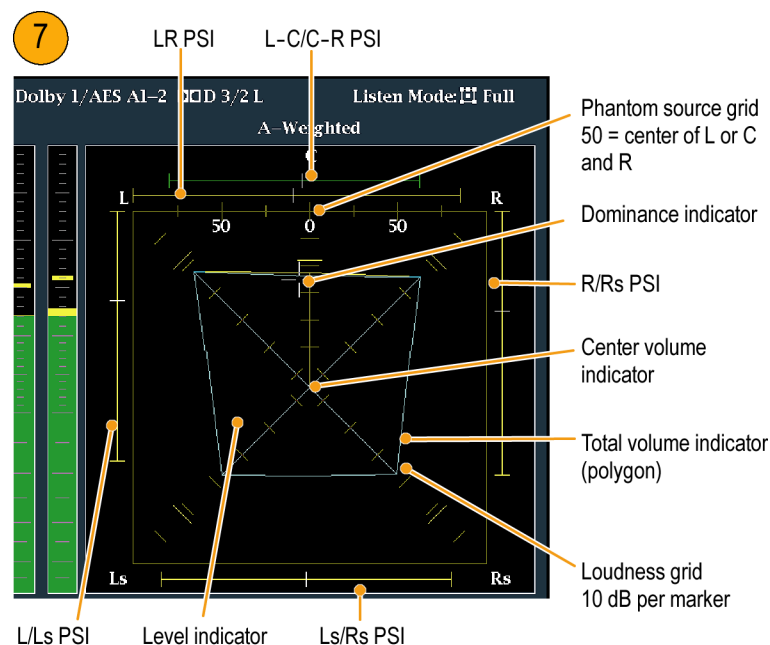
Figure 59: Surround sound indicators

NOTE. The Audio Surround Sound display is courtesy of Radio-Technische Werkstaetten GmbH & Co. KG (RTW) of Cologne, Germany.

Elements of the Surround Sound display

- Level Indicators – indicate the audio level balance among the left (L), right (R), left-surround (Ls), and right-surround (Rs) channels as cyan lines on the Loudness Grid.

- Loudness Grid – the ruled scale, radiating from the center, on which the level indicators register their audio level and balance. The scale has tic marks at 10 dB intervals. An additional tic mark indicates the –18 dB level. The –18 dB and –20 dB levels are typically used for aligning audio levels.

- Total Volume Indicator – the cyan polygon formed by connecting the level indicator end points, showing the total sound volume of the L, R, Ls, and Rs channels. Each connecting line bends away from the center if the two signals have a positive correlation, bends toward the center if the signals have a negative correlation, and do not bend if the signals are uncorrelated.

- Center Volume indicator – displays the sound volume of the center channel as a vertical yellow bar between the L and R channels, and connects the ends of the L, C, and R audio level indicators with straight lines.

- Channel-Pair Phantom Sound Indicators (PSIs) – located on each side of the Surround Sound display, indicates the location of potential phantom sound sources formed by adjacent channels. The white tic marks on these moving bar indicators show the phantom source locations. The bar length indicates the correlation between the adjacent channels. A short-to-medium length green bar indicates positive correlation between the channels, forming a localized phantom sound source located at the white tic mark. The bar grows to full length and changes color to yellow as the correlation moves to zero, indicating a wide, non-localized sound image. The bar changes color to red for adjacent channels with significant negative correlation. For negative correlations, the ends of the PSI for the L and R channels continue to grow at a 45° angle while the other PSIs remain at full length.

- Center-Pairs Phantom Sound Indicator – a fifth PSI at the top of the display shows potential phantom sources formed by the LC channel pair and the CR channel pair. If the L, R, and C channels all have the same signal level, the white tic mark on the bar appears directly above the C level indicator. The white tic mark moves right or left depending on the relative balance between the three channels. A short bar to the left of the white tic mark indicates a positive correlation between L and C. The bar grows as the correlation decreases. Like the L-R PSI, the bar continues to grow at a 45° angle for negative signal correlations. The bar to the right of the white tic mark behaves similarly, depending on the C-R correlation. This PSI indicator uses the same color coding as the other PSI indicators.

Usage notes   The displays shown here are examples of how the surround sound waveform appears for some typical signal types.

1. Uncorrelated signals: same level in the L, C, R, Ls, and Rs channels.

2. Sine wave test tone: same level in the L,C, R, Ls, and Rs channels. All signals are in phase, creating phantom sources between the adjacent channels.
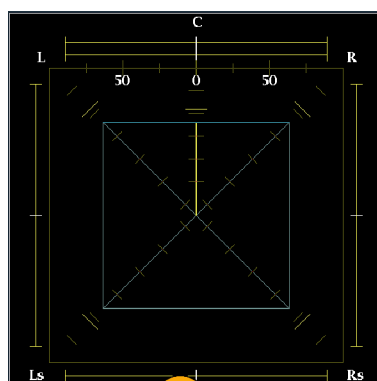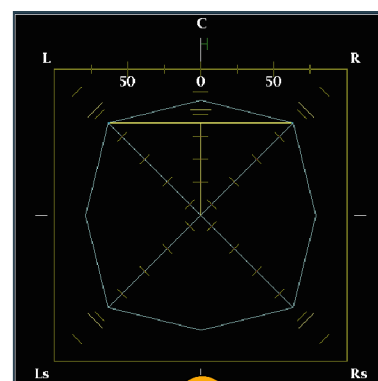
3. Same as 2, with the exception that Channel L is out of phase.

4. Surround sound program with strong center channel presence.
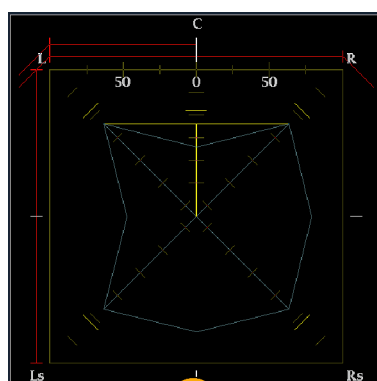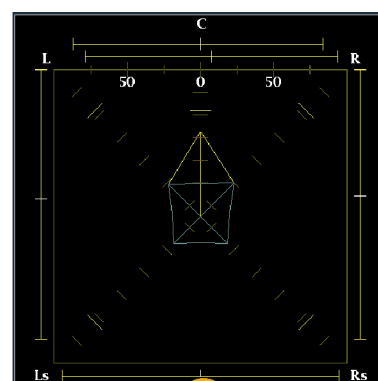
5. Surround sound program with weak center channel presence.

6. Monaural signal in channels Ls and Rs, creating a phantom source in the center, as in a 3.1 surround sound system.
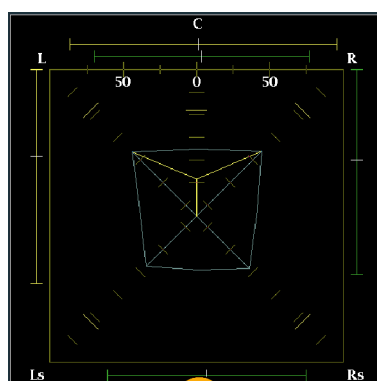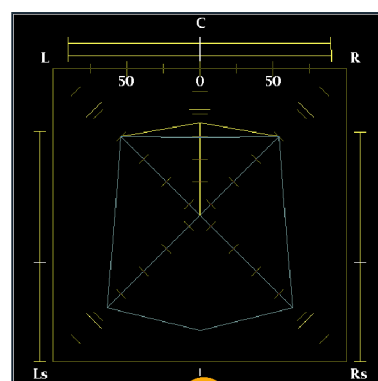
Closed captioning (CC), teletext, AFD, and safe area compliance

With Option DATA installed, this instrument can monitor for CC data (including V-Chip ratings) present in the selected signal and display that data overlaid on the Picture display. (CEA 608 (VBI), CEA 608 (ANC), CEA (608/708), CEA 708, TeletextB (VBI), TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC) closed caption transports are supported.

Your instrument can also display Safe Action and Safe Title graticules, allowing you to monitor for incorrect placements of graphics, logos, and other branding elements. This will help you ensure that those items do not obscure text or essential action. SMPTE, ITU, and ARIB TR-B.4 standards are supported.

NOTE. CC/Teletext format monitoring is tile specific. To simultaneously monitor more than one format, select the appropriate settings in the desired tile.

Monitoring CC and teletext

Perform the following procedures before monitoring CC and Teletext.

To configure CC and teletext

1. From the CONFIG menu, select **Aux Data Settings**.

2. Select from the following CC types:

   - CEA 608 Settings (See page 176.)

   - CEA 708 Settings (See page 177, *Configuring CEA 708 settings*.)

   - Teletext B Settings (See page 177, *Teletext b settings*.)

Configuring CEA 608 settings.

1. Select **CEA608 Settings** from the Aux Data Settings submenu.

2. Select **CEA608 Required** and then select **Yes** or **No**, depending on whether you want to monitor for required settings.

3. Select **CEA608 Transport**, and then select from Auto, Line 21, S334 (RAW), or S334 (CDP). If you select **Auto**, the instrument will search for any available transport.

4. Select **VBI Mode**, and then select Auto or Manual. If you select **Manual**, set **VBI Line Num** using the General knob.

5. Select **VBI Timing** and select Normal, Early, or Late.

6. If required services is set to Yes, select **Req Services** and press the **SEL** button. This will show a dialog box that allows you to select CC and Text required channels.

Configuring CEA 708 settings.

1. Select **CEA708 Settings** from the Aux Data Settings submenu.

2. Select **CEA708 Required** and select **Yes** or **No**, depending on whether you want to monitor for required settings.

3. If required services is set to Yes, select **Req Services** and press the **SEL** button. This brings up a dialog box that allows you to select CC and Text required channels.

Teletext b settings.

1. Select **Teletext B Settings** from the Aux Data Settings submenu.

2. Select **Teletext Required** and select **Yes** or **No**, depending on whether you want to monitor for required settings.

3. Select **WST Transport**, and select from Auto, VBI, OP47 (SDP), or OP47 (Multi). If you select **Auto**, the instrument searches for any available transport.

4. If required services is set to Yes, select **Teletext Req Pages** and press the **SEL** button.

5. When Teletext Required Pages dialog box appears, use the General knob to navigate to the box in the **Allow Alarm** column that is next to the page for which you want monitor.

6. Press the **SEL** button to mark the box.

7. Press the right arrow key and then press the SEL button to highlight the **Page Number** box.

8. Use the General knob to set the box to the desired page number and press the **SEL** button.

9. When you are finished with your selections, use the down arrow to navigate to the **Return** box and press the **SEL** button.

To view CC status and subtitles

1. Select a tile.

2. Press and hold the **STATUS** button to display the Status pop-up menu.

3. Select **Display Type**.

4. Select **Aux Data Status**. The Auxiliary Data Status display shows the status of the closed caption data. (See Figure 60.)
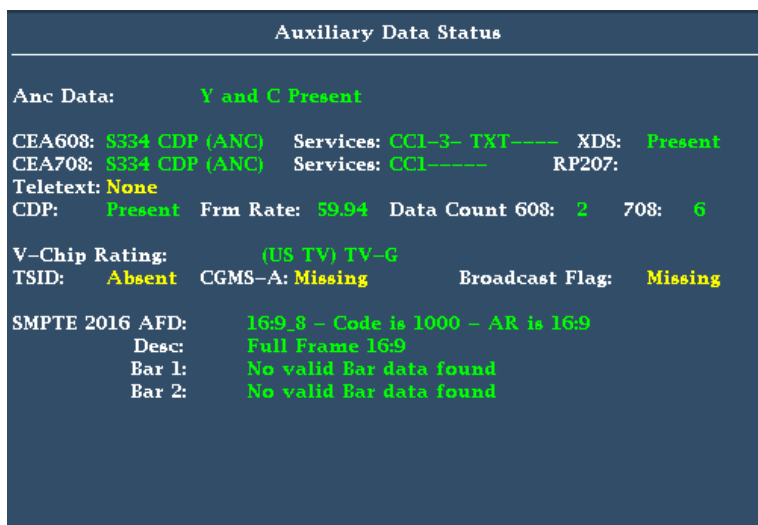
Figure 60: Auxiliary Data Status display

To display CC
1. Select a tile.

2. Press and hold the **PICT** button to display the Picture pop-up menu.

3. Select **CC/Teletext Format** and select the CC type, if any, you want to display.

4. Select the channel, service, or page to display.

   The Picture display includes Closed Captioning in the area designated by the Closed Caption data. (See Figure 61.)

5. Press the **PICT** button again to dismiss the Picture pop-up menu.

Closed Captioning Display Area is determined by the Closed Caption data
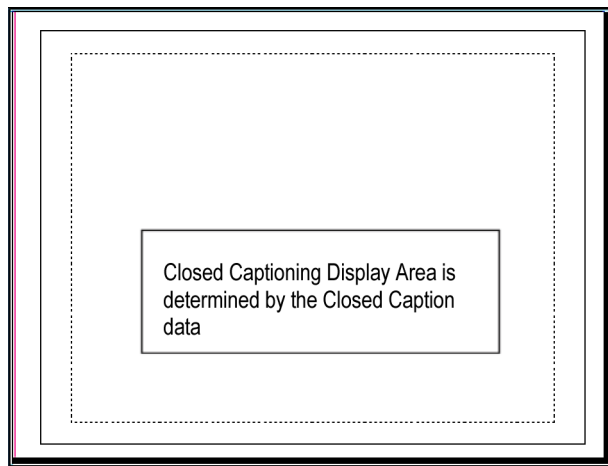
Figure 61: Closed caption display area

Usage notes
- PICT displays in individual tiles allow their Services and Pages to be selected independently.

- CC text is not captured with the Picture image when using Freeze.

- CC/Teletext setups are also stored when saved with Presets and restored at power on.

- The CC alarms are available from the Configuration menu in the Alarms submenu under Closed Captions/Metadata.

- Teletext can be viewed as captions or as a whole page.

Monitoring for safe area compliance

To display graticules for monitoring for incorrect placements of nonessential elements relative to essential ones, set global settings in the Configuration menu and turn on up to four Safe Area graticules, each with independent settings, in the Picture menu.

To configure Safe Area graticules

Before using Safe Area Graticules, configure them from the Configuration menu by performing the following steps:

1. Select **Graticules** and then select **Safe Area Graticule Standard** from the CONFIG menu.

2. Choose from the **SMPTE**, **ITU**, or **ARIB TR-B.4** standards. The selection you choose will be the graticule used when **AUTO** is chosen for any of the four Safe Area Graticules, accessed in the Picture menu.

3. To set the Height, Width, and Offsets of the title and action areas for Custom Safe Graticules 1 and 2, first select the title or action to change.

4. Set the percentage level for each of the parameters. Parameters are set as a percentage of screen height or width, and you can watch the graticules update on the screen as you change them.

*NOTE. The custom parameters you set are used when **Custom_1** or **Custom_2** is chosen for any of the four Safe Area Graticules accessed in the Picture menu.*

To display Safe Area graticules

1. Select a tile.

2. Press and hold the **PICT** button to display the Picture menu.

3. Select **Safe Area Action 1**.

4. Select one of the following:

    – **Auto** to let the instrument automatically select the size and offsets of the safe area.

    – **4x3**, **14x9**, or **16x9** to set the safe area size and offsets appropriate for these aspect ratios based on the selected standard.

    – **Custom_1** or **Custom_2** to set the safe area size and offsets to match the custom settings in the Graticules Configuration menu.

5. After setting each Safe Area selection, press the **PICT** button to dismiss the pop-up menu.

Usage notes
- The Safe Action Area shows the maximum image area within which all significant action should be contained; the Safe Title Area shows the maximum image area within which all significant titles should be contained. (See Figure 62.)

- Safe Area Graticules can globally be configured to comply to accepted standards in the Configuration menu.

- Custom selections for vertical and horizontal size and offset of the Save Areas can be set in the Configuration menu.
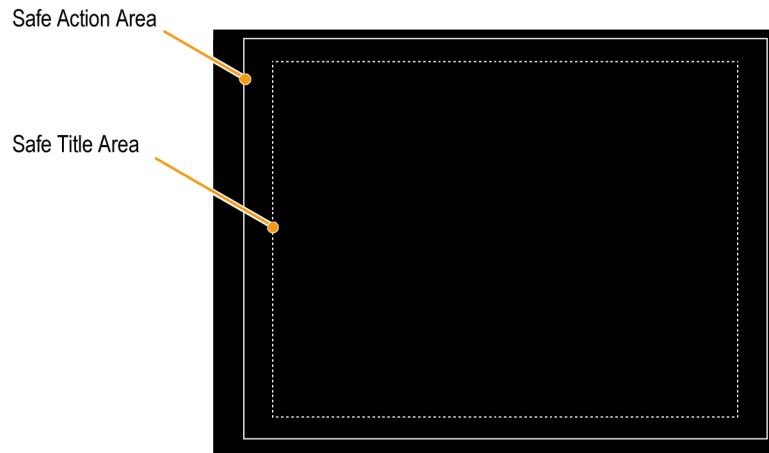
Figure 62: Safe Action and Safe Title areas

Monitoring for AFD compliance

To display graticules for monitoring for AFD compliance, you must turn the graticules on from the pop-up menu in the Picture Display. View information about AFD graticules on the Auxiliary Data Status display.

To configure AFD graticules

1. Press and hold the **PICT** button to display the Picture menu.

2. Select **AFD Graticules** and then select **On**.

   View the graticules in the Picture display. AFD information can viewed in the Auxiliary Data Status display. (See Figure 60 on page 178.)

Remote Web interface

The instrument can be accessed four ways over an Ethernet network:

- Use a Web browser to access the instrument Web page.

- Download a Java applet to allow control and display of a virtual front panel.

- Load a Java application onto the host PC to allow control and display of a virtual front panel.

- Use SNMP, where commands can control the instrument and the instrument can send traps in response to error conditions.

Web browser

Using only a Web browser, you can access the instrument Web page. To access this page, simply enter the IP address of the instrument into a Web browser on a computer. From this page, you can save screen captures, download presets, view the event and diagnostic logs, and even browse the online help. You can also download a Java applet or the SNMP MIB.
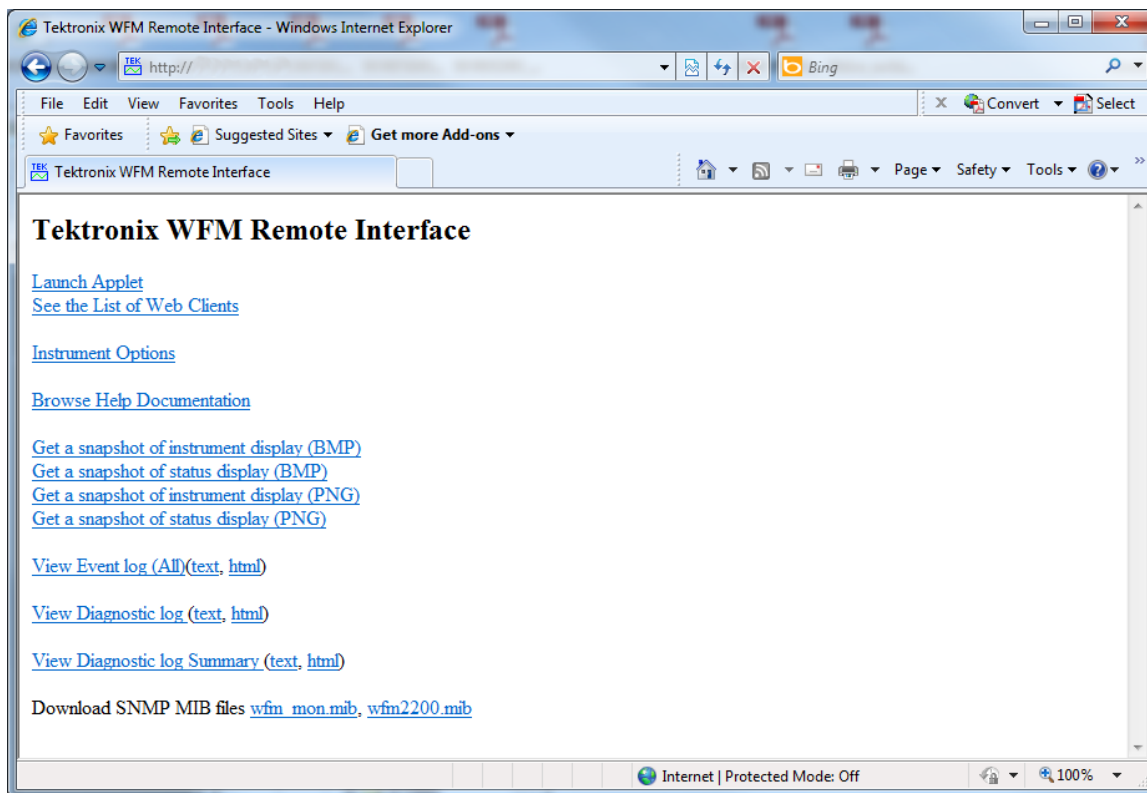
Figure 63: Remote Web interface

Java applet

If you have the correct system configuration, you can download and launch the Java applet (referred to as "remote applet") from the instrument Web page. The remote applet provides a menu bar and a virtual front panel that gives complete control over instrument settings from a remote computer. The remote applet can also show the instrument displays at a rate of a frame every few seconds.

Java application

A Java application (referred to as "remote application") can be downloaded from the Tektronix Web site and loaded onto a PC. The remote application is very similar to the remote applet, but it has greater capability for storing presets, since it has access to storage on the host machine. The remote application also starts more quickly than the applet since it does not have to download over the network each time it runs.

The remote application also permits you to access several unique utilities and settings that relate to WVR remote display refresh rate. See Settings... dialog for more information on how to use these features.

NOTE. Java version 1.4.1 or higher is required for proper operation of both the Web applet and the application. For operating the applet, you should use Microsoft Internet Explorer version 6.0 or higher. Netscape 6.22 and Mac OS X have exhibited some problems with window re-sizing, so users who wish to use these browsers are encouraged to download the application instead of using the applet. Operation with other browsers or versions has not been verified.

Network access

Network access can be controlled by parameters in the CONFIG menu under the Network Settings submenu. These settings allow you to enable or disable access through the network, set community strings, and set addresses. (See page 16, *Configure the network interface*.)

NOTE. Some Web browsers interpret IP addresses with leading zeros as octal numbers. For example, if the address of the instrument is of the form 124.161.038.151, then enter it in the browser as 124.161.38.151.

SNMP control

SNMP control is primarily intended for access by means of automation systems. The complete SNMP MIB can be downloaded from the instrument Web page. You can also download a printable version of the MIB from the Tektronix Web site: www.tektronix.com/manuals.

SNMP Traps can be sent to up to four addresses when error conditions are detected. (See page 16, *Configure the network interface*.)

Use the CONFIG menu to set various parameters that will generate SNMP trap error reports. Some of those parameters are listed below.

- Use the menu selections under **Gamut Thresholds** to set the minimum and maximum gamut limits for composite signals derived from the SDI signal, set the minimum and maximum luma levels, and specify the percentage of the total image pixels that can be outside the current gamut or luma limits and not generate error reports.

- Use the menu selections under **Alarms** to enable various alarms that will be reported in the log.

- Use the menu selections under **Aux Data Settings** to set various expected data parameters.

General information

Screen resolution

Web interface operation is optimized for screen resolutions of 1024 x 768 or higher. Operation on computers with lower resolution has not been verified.

Multiple clients

The instrument supports up to three remote clients simultaneously. The remote display update rate decreases with multiple clients.

Screen capture

The screen capture for a remote display can be corrupted if the settings are changed on the remote instrument while the screen capture is in process. The result is a capture that is a mix of the settings before and after the change was made. This only effects a screen capture in progress when the change is made. Subsequent captures, taken when no setting changes are occurring, will be correct.

Web interface and SNMP command conflicts

If you run the Web interface and at the same time send a very high rate of SNMP commands, then the Web interface may not always display the true state of the instrument. Usually the Web application will recover with a few seconds of break in the SNMP command stream. In extreme cases, you may fill up the allowed memory on the PC running the Web applet or application and have to stop and restart the Web program to recover.

Application examples

Timing a studio

Your instrument supports multiple methods and techniques for timing a studio, all of which require an external reference to your instrument. Timing a studio involves adjusting the references going to different sources so that their output feeds have the same timing when they arrive at a common point, such as a production switcher. For digital systems, timing typically must be close, but not exact, because most switchers have some tolerance for timing errors. For analog composite systems, the timing may need to be matched within a small part of a subcarrier cycle to prevent hue shifts when switching between sources.

Following are procedures for timing a studio using various methods.

Using the traditional method

Your instrument makes the traditional method of comparing Horizontal and Vertical timing easier by providing flexible tiles and a Freeze function. To time a studio using the traditional method, you store an input as a baseline and compare signals that you time against the baseline.

1. Select a tile in which to time the active input. Select **WFM**.

2. Apply the first input signal to the appropriate input, terminate it properly, and select it.

3. Push and hold the **WFM** button. From the **Display Mode** submenu, select a display mode that is appropriate to the signal that you input.

4. Apply the house reference signal to the external reference input, terminating it properly.

5. Press the **EXT REF** button to select External Reference mode. (Connected to the house reference.)

6. Put the selected tile in line mode Using the **SWEEP** button menu.

7. Use the **HORIZONTAL** knob to center the sync edge or the SAV pulse. (If using the SAV pulse, turn off Stripping EAV/SAV/ANC in the SDI Input setting of the Configuration Menu.)

8. Press the **MAG** button to increase the timing resolution.

9. Activate another waveform display in a second tile.

10. Press and hold the **SWEEP** button and select **FIELD** to put the display in field mode.

11. Use the **HORIZONTAL** knob to center the vertical interval.

12. Press the **MAG** button to increase the timing resolution.

13. Press the **CAPTURE** button to save the waveform as a baseline.

14. Apply an input that must match timing of the first input.

15. Adjust the timing offset of the signal being timed to match the timing to the saved baseline.

16. Repeat steps 14 and 15 for any other required signals.

NOTE. Use the Cursors as markers or to measure timing differences between sources.

Other tiles can be used to set fine timing and check color frame alignment on composite signals. Alternatively, the other two tiles could be used for line and field rate displays without Mag active to show the location of significantly mistimed signals.

Using the Timing display method

The Tektronix Timing Display provides a quick, easy way to measure the timing of an input relative to the external reference:

■ The rectangular display automatically scales to match the input signal. For progressive signals, the display represents one field; for interlace signals, the display represents one frame; and for composite inputs, the display represents one color frame.

■ The cross-hair in the center represents zero offset, and the circle represents the timing of the input signal. Lines of advance or delay are shown as vertical displacement, while timing errors of less than one line are shown as horizontal displacement. If the input is at the same time as the reference, then the circle will be centered on the cross-hair.

■ The timing offset is also shown numerically as lines and micro-seconds of advance or delay in the boxes at the right side of the display.

■ For input and reference signals with closely related frame rates, there is only one timing relationship, so a single circle is shown on the display to indicate the timing offset of the input signal.

■ For input and reference combinations with more complex relationships, multiple circles are displayed to indicate all the possible interpretations of the timing offset, with the one that is closest to zero shown with emphasis. The numerical readouts will correspond to the timing indicator circle with the emphasis.

■ The **Relative to:** box indicates the chosen zero point for the timing display. The default is Rear Panel. In this mode, the offset is zero when the input and reference are at the same timing at the rear panel of your instrument. The other choice is Saved Offset. In this mode, you can save the timing from one signal and then display the timing relative to that saved offset.

To use the Timing display to time a signal to a reference.

1. Select a tile in which to time the active input.

2. Apply the input signal to be timed to the appropriate input, terminate it properly and select it.

3. Apply the house reference signal to the external reference input, terminating it properly.

4. Press the **EXT REF** button to select External Reference mode.

5. Press the **MEAS** button to select the Timing display for the tile selected in step 1.

6. If only one circle is displayed, adjust the timing offset of the black generator to match the timing to the external reference. Adjust for a perfect coincidence of the circle around the reference target (circle turns green at coincidence) and null values of the vertical and horizontal timing readouts.

7. If multiple circles are displayed, the timing is complex, and you must choose the one you want. The measurement that is closest to zero offset is displayed with emphasis and appears in the readouts.

NOTE. See Timing Displays for Simple Versus Complex Timing for more information about complex timing displays and their elements. (See page 108.)

9. Repeat step 6 or 7 for any other signals.

NOTE. As you adjust timing, the circle representing the input timing may jump occasionally. This is because the color frame detection circuit can be temporarily disrupted as the signal shifts. The jump is often a multiple of the field time. The circle will settle back to the correct location in a second or so.

Timing multiple inputs to a router

Use the **Relative to:** function to set the offset between a master signal and a reference signal as the zero-point reference for time-down applications. The **Relative to:** box indicates the chosen zero point for the timing display:

■ **Rear Panel.** In this mode (default), the offset is zero when the measured signal input and reference are at the same timing at the reference at the instrument rear panel. This setting was used in the Timing Display Method procedure.

■ **Saved Offset.** In this mode, you can save the timing from a master signal relative to the reference as the zero point offset. Then route other inputs and measure relative to this saved offset.

To time the inputs to a router.

1. Perform steps 1 through 5 of the previous procedure.

2. Route the signal you want as the master to the appropriate input, SDI or Composite, and terminate properly.

3. Route the reference signal to the reference input and terminate appropriately.

4. Save the timing offset for the master input (**MEAS > Save Offset > SEL**) and select the **Relative to: Saved Offset** mode from the pop-up menu.

NOTE. You cannot save the timing offset if either the input or reference is missing or unlocked. You also cannot save a reference when in internal mode. Saving an offset in these conditions would lead to misleading results so it is not allowed by the instrument. A warning message will appear on the screen if you attempt to save the offset when it is not allowed.

---

5. Now select other inputs to the router to be connected to the instrument. For each input, the relative timing will be displayed.

6. Adjust the timing offset at the master sync source to time down the inputs to the router to match the master.
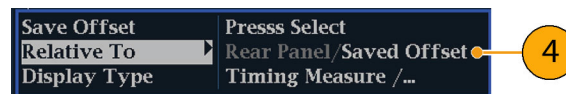
Usage notes.

■ The resolution of the timing display for SD signals is one 27 MHz clock cycle or 37 ns. For HD signals, it is one clock at 74.25 MHz, which equates to about 13.5 ns. To get the greater accuracy needed for a composite signal, first use the timing display to get close, then use a vector display for the final burst phase alignment. Since the instrument can display both the timing display and a vector display simultaneously (each in its own tile), this process can still be easy and quick.

■ For an SDI input relative to an analog reference, the situation is more complex. For the timing display, three definitions of "zero offset" on an SDI input are supported, Analog (DAC) and Serial (0H) and Saved Offset.

The **Analog (DAC)** setting uses the methodology illustrated in appendix B of SMPTE RP168. This method shows the SDI signal being converted to analog. The converted analog signal is then compared to the analog reference. For this mode the nominal delay of the D to A converter is assumed to be 4.6 microseconds for SD, 1.3 μs for HD and 0.0 us for 3 Gb. The 0.0 μs delay for 3 Gb means the Analog (DAC) and Serial (0H) modes are equivalent for 3 Gb signals.

The **Serial (0H)** setting, uses the methodology implied in appendix A of SMPTE RP168. In this mode timing is considered to be zero when the 0H sample of the serial stream aligns with the reference edge of the analog sync. Note that this timing is actually at the scrambled interface which is slightly different than timing to the parallel data into the serializer or the parallel data out of the deserializer due to delays in those functions.

■ In the **Relative to: Rear Panel** mode, this 3 µs conversion delay is removed from the measured offset before the display is generated. In the **Relative to: Saved Offset** mode, it has no effect.

In the **Relative to: Saved Offset** mode, the timing of one signal is "saved" and then that becomes "zero" for subsequent measurements. This removes any need for a specific definition of zero timing, since the display shows the difference in timing between the initial and current signals.

■ This timing relationship between input and reference is also compatible with the waveform mode. That is, if you have zero timing on the Timing display and change from internal to external reference, the displayed waveform will not shift position.

■ You can use the External Reference Waveform display to troubleshoot problems with the reference signal. (See page 67, *External Reference Waveform display*.)

NOTE. If you have an input and reference combination that requires multiple timing indicator circles, then it can be misleading to compare timing offsets between multiple inputs. Because the timing display chooses the smallest of the possible timing offsets, if a large timing difference exists between two inputs, then they may not be matched. This problem also occurs using traditional timing methods unless you use something similar to the SMPTE318 10 field flag to identify a specific sub-multiple of the reference.

Troubleshooting cable problems

You can use this instrument to generate a test signal that you can route through your studio and back to the instrument to troubleshoot problems with signal cables. The following procedure tests both SD and HD signals.

1. Press and hold the **GEN** button, and then use the arrow keys to set the **Display Type** selection to **Generator Status**.

2. Use the arrow keys to set the following signal characteristics:

   - Set the **SDI Output** selection to **Test Signal**.

   - Set the **Signal Pattern** selection to the desired test signal type.

   - Set the **Signal Level** selection to **Level A**.

   - Set the **Signal Format** selection to **SD SDI 525i**.

3. Connect the SDI output from the instrument directly to one of the SDI inputs on the instrument (SDI A or SDI B).

4. Press and hold the **STATUS** button, and then use the arrow keys to set the **Display Type** selection to **Video Session**.

5. In the Video Session display:

   a. Press the **SEL** button to reset the video session display.

   b. Verify that the signal format matches the format that you selected for the SDI output signal.

   c. Make a note of the displayed values for the **F1 AP CRC** and **F2 AP CRC** entries. The CRC values depend on which test signal you selected to output from the instrument.

6. Connect the SDI output of the instrument to an input link in your video system.

7. Connect the output of your router or patch panel to one of the SDI input connectors on the instrument (SDI A or SDI B).

8. In the Video Session display:

   - Verify that the signal format matches the format that you selected for the SD-SDI output signal.

   - Verify that the displayed values for the **F1 AP CRC** and **F2 AP CRC** entries are the same as you noted in step 5.

   - Verify that no CRC errors are reported, which indicates an error free transmission of the signal through the system.

9. Press and hold the **GEN** button, and then use the arrow keys to set the **Signal Format** selection to one of the 720p, 1080i, or 1080p formats.

10. Press the **STATUS** button to return to the Video Session display.

11. Press the **SEL** button to reset the Video Session display.

12. For one minute, check the following In the Video Session display:

    - Verify that the signal format matches the format that you selected for the HD-SDI output signal.

    - Verify that **OK** is displayed as the status for the **Y Chan CRC Error** and **C Chan CRC Error** statistics.

    - Verify that the **Err Secs** readouts for the **Y Chan CRC Error** and **C Chan CRC Error** statistics are not increasing each second. If the Err Secs value(s) are increasing each second, then you are approaching the digital cliff where errors will occur.

13. Repeat steps 1 through 12 to test SD and HD signals through each input link to your video system.

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